GRAPHIC GEOGRAPHY

THE RURAL SCENE

by

EDGAR FORD
Geography Master, Fort Street Boys' High School

and

BROCK ROWE
Vice-Principal
Wagga Teachers' College

ANGUS AND ROBERTSON
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INTRODUCTION

This book has been written to further the geography studies of senior pupils in secondary schools. At the same time it will be found to contain useful reference material for certain aspects of junior work.

Prominence has been given to the economic geography of man's activities with just such emphasis on the physical side as should lead to a fuller appreciation of them.

The method of approach is not new. It is claimed, nevertheless, that not only are many of the maps particularly useful from a teaching point of view, but that stress has been laid on the closer relationship which should exist between them and the textual material. In this way the map takes its proper place in becoming basic to geography work in schools. In order to help in this direction the sketches and their related text have been kept as close together as possible in the layout of the book.

The treatment is broad and not too technical in either subject matter or terminology. At the same time similar topics have been approached in different ways so as to give added interest and variety to them.

The use of a tabulated form of text is intended to help in the logical development of material and to show the relative importance of the various geographical aspects of each subject selected for study. This method should not be regarded as a model for all types of written exercises.

The maps will be seen to vary from those of a more complicated nature, which can be made the basis of class discussion, to simple line drawings, which pupils may well use in their own studies. The method of using different kinds of shadings, a scale, and good descriptive titles is one to be followed to advantage.

Map summaries of the kind presented at various points herein will provide the student with models for preparing all sections of the course for examination purposes.

The book is by no means intended to be exhaustive, as it is the firm belief of the authors after long experience that really good geography studies can be made only with the effective and continued use of a reference library. A short bibliography of books used by the writers in their own class work will be found in *Regions and Men.*

The complete course is covered in this book and its companion volume, *Regions and Men.*

ACKNOWLEDGMENTS

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CONTENTS

LIST OF MAPS AND DIAGRAMS

1

GEOGRAPHICAL FACTORS

Geography in its widest sense is the science of the earth's surface; but in this book it is concerned essentially with the study of mankind in relation to his environment. Such a study entails some description of the environment as well as of the various activities found within it. Despite the great technological progress made by many groups of mankind the natural environmental factors still exert a powerful, sometimes a controlling, influence over man's activities, especially those concerned with farming; for here man has been forced by climate and topography to adopt specific uses of the land.

For the purpose of general description the environment is regarded as being composed of (*a*) *natural* and (*b*) *cultural* (man-made) factors. The geographical account of any activity should therefore select from such of the following features as are appropriate.

Features of a geographical description. A: Natural factors. These are the endowments of nature in the area, the chief of them being:

1. Location and size. This is generally best shown by using a map on which are drawn reference lines (a parallel of latitude and a meridian of longitude) and a scale.

2. Surface features.

(*a*) Landforms: Distribution, relief and general characteristics.

(*i*) Plains.

(*ii*) Plateaux.

(*iii*) Mountains and hill country.

(*b*) Drainage patterns, especially where they are significant to occupational and settlement patterns.

3. Climate. Here the description should be confined to those climatic elements of significance to the occupational activities.

(*a*) Temperature.

(*i*) Annual average.

(*ii*) Annual range, with special reference to winter conditions.

(*iii*) Duration of the frost-free period.

(*b*) Rainfall.

(*i*) Annual total.

(*ii*) Seasonal distribution, noting particularly the occurrence of significant rainfall for crop growth, that is, rainfall during the growing period.

(*iii*) Reliability.

4. Water resources. Ground water and artesian water and their relation to land use.

5. Soils.

(*a*) General physical and chemical properties.

(*b*) The erosion factor.

6. Vegetation. A brief description of forests and grassland areas and types where they are significant to the land occupancy.

7. Economic mineral resources and their distribution. Coal and iron are especially important here; but the non-ferrous minerals should not be overlooked.

B: Man-made (cultural) factors. These are concerned with the various uses to which man puts the natural factors and the patterns derived from them.

1. Farming features.

(*a*) The size and lay-out of farms and fields.

(*b*) Crop and animal specialization and general farm routine.

(*c*) Patterns derived from agricultural practices.

(*d*) Irrigation in farming.

2. Manufacturing.

(*a*) Location and collection of raw materials.

(*b*) General outline of processing activities, noting particularly any industries associated with the main processing one.

(*c*) Relation of fabricating plants to processing centres.

(*d*) Destination of processed articles, that is the relation of manufacturing to markets.

3. Transport.

(*a*) Major types used: road, rail or water.

(*b*) Relation of activity under discussion to transport routes.

(*c*) Pattern and density of routes.

4. Settlement types and patterns.

(*a*) Villages and towns: dispersed and agglomerated settlements.

(*b*) Larger agglomerated settlements and cities.

(*c*) Functions of towns and cities.

(*d*) Activity patterns within towns and cities.

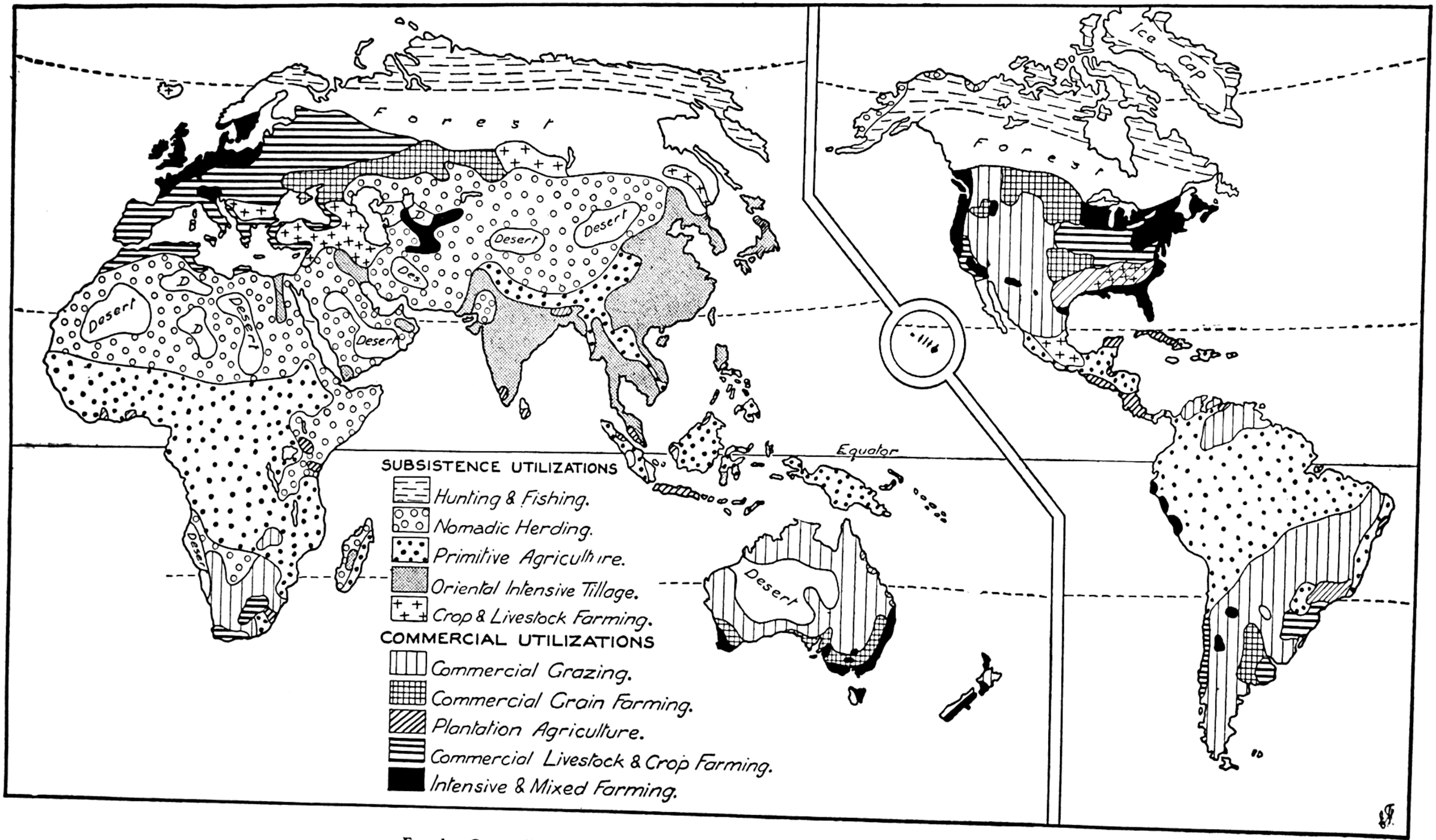

FIG. 1. Generalized pattern of land utilization throughout the world.

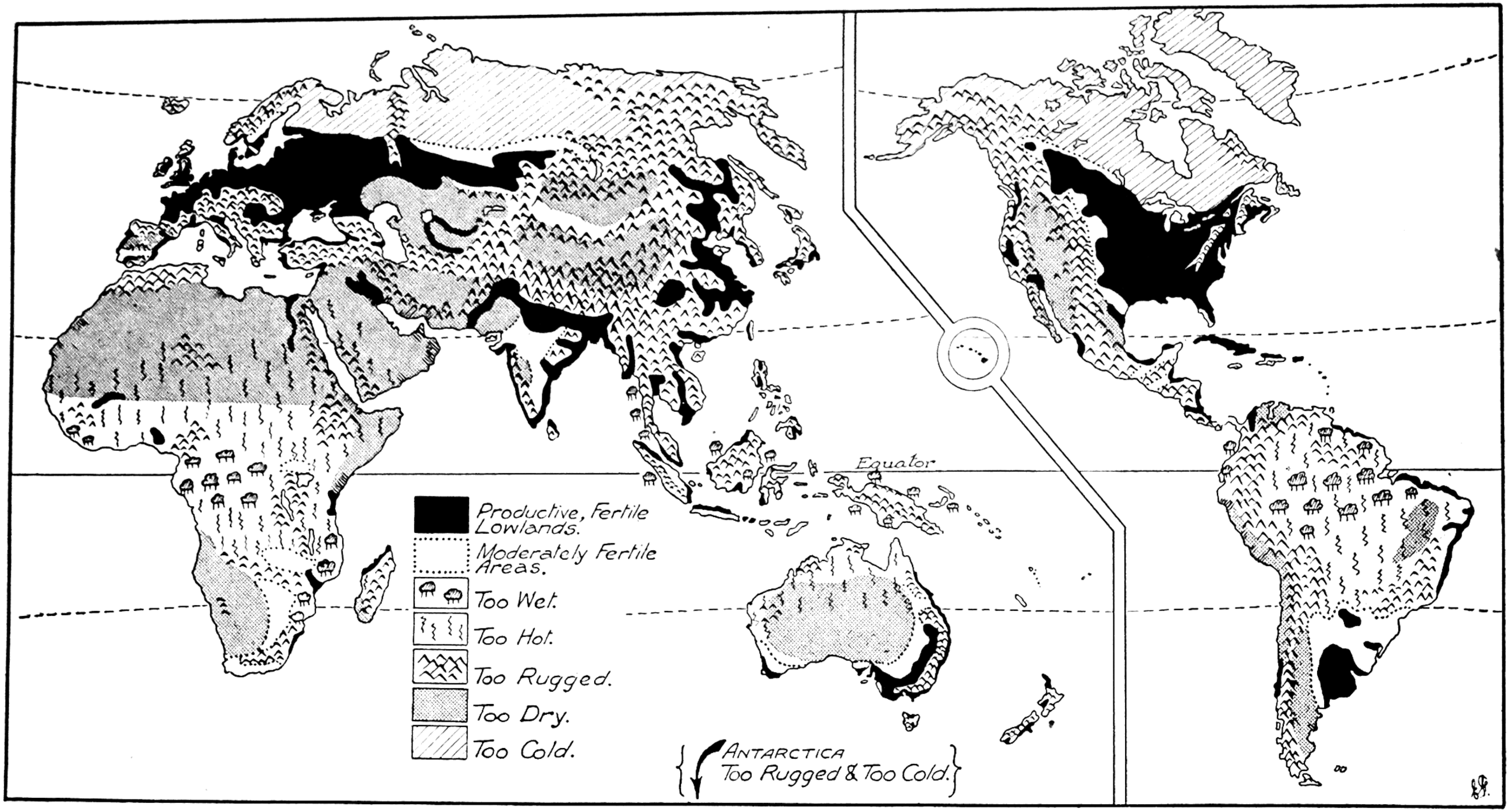

FIG. 2. Generalized pattern of some of the main controls of farming land use throughout the world.

A NOTE ON WORLD MAP PROJECTIONS

Figures 1 and 2 and all other world maps throughout this book are drawn on a special projection devised to retain equal-area properties while showing as large a land area as possible on the space available.

The original projection in this case was an Aitoff elliptical equal-area one, and the first change was made by re-centring each of the continental masses about a central meridian. This split the ellipse into five sections, two in the northern and three in the southern hemisphere. It also resulted in a much better continental shape than was possible in the elliptical form.

The second change was to eliminate the huge expanse of the Pacific Ocean by "sliding" the Americas along the parallels of latitude as close to Asia and Australasia as possible. This break, known as interrupting, is indicated by the double line in that region.

The map therefore is called an "equal-area, re-centred, interrupted Aitoff projection". This type (often using the Mollweide type instead of the Aitoff) is becoming very popular in modern geography because of its great advantages for portraying land distributional features throughout the world.

5. **Population** pattern and density.

6. **Economic factors and Government policy** in relation to farming or manufacturing activities. Bounties, tariffs, market prices, control of output, marketing boards, decentralization of industry.

7. **History.** The history of the area or activities in it, in so far as it may help to explain present distributions and patterns.

8. **Regional geography.** The regional pattern and integration of activities within the region.

Farming types and some controls of land use (Figure 1). Figure 1 shows the general pattern of farming types throughout the world, for on it are plotted the major regions differentiated by using the dominant farming practice within each.

1. It should be noted that all the types are grouped into the two main classes of subsistence and commercial farming, and some explanation of these terms is now necessary.

2. Subsistence farming is that type of land use wherein the aim of the farmer is to produce food and clothing for himself and his family.

3. Commercial farming is concerned with the production of farm products for sale outside the farm itself, often outside the entire farming region.

4. No farming region exists entirely without some exchange of products and no commercial farmer sells all the products of his land; but in this study we are concerned with the intention of the farmer when he plants his crop or manages his herds and flocks.

5. Several important features are associated with each of these main types:

(*a*) In subsistence farming areas:

(*i*) The unit of settlement is usually small, varying from a family group with the nomadic herders to a village of perhaps one thousand inhabitants in the intensively cultivated rice lands of south-east Asia.

(*ii*) There are very few roads and no railways in these lands except where they have been introduced by more advanced Western peoples in order to exploit some economic feature in the area. This absence of major transport routes is due to the very small trade carried on in farm products.

(*iii*) There are very few large towns and cities in subsistence farming lands. The few cities that exist are concerned with defence and government administration. China, before European penetration, was an excellent example of this feature.

(*b*) In commercial farming areas:

(*i*) The unit of settlement is the farmhouse, usually on the farm property; but trading villages and towns are scattered over the whole farming area.

(*ii*) There is always a network of roads and railways linking, first, the farm to the town centre, and secondly, the town centre to the distant markets. Such a transport pattern is essential for the movement of the farm produce outwards to the markets and for the inward movement of consumer goods to the towns where the farmer purchases his food, clothing and farm requirements.

(*iii*) As the principal market for commercial farm products is in large towns and cities, each farming area is part of the hinterland of a city or group of cities, which in themselves are concerned primarily with trading and manufacturing activities. Thus in commercial farming areas there has developed an interdependent grouping of farm—transport route—town (or city), each member of which is essential to the others.

6. A general examination of this map will show:

(*a*) The greater part of the land surface of the earth is either unoccupied or sparsely occupied by subsistence farming populations.

(*b*) The commercial farming types are confined almost entirely to sub-tropical and temperate latitudes, with the exception of the plantation types, which are found scattered throughout the tropics.

Some controls of land use (Figure 2). Figure 2 summarizes the various controlling factors that create the pattern of land use shown in Figure 1. The major controls noted are:

(*a*) Landforms, where plains and lowlands alone are fully favourable for extensive and intensive farming development. Not all plains are so favoured because the climatic factor is also a strong determinent in land use.

(*b*) Climate. Only the unfavourable factors are shown on the map. Areas marked as very favourable or moderately favourable for development mostly have climatic conditions suitable for farming.

Areas marked as too wet, too hot, too dry, too rugged or too cold are not incapable of some development. Many parts of them are settled; but, except for mining centres and small irrigation settlements, the population pattern is a scattered one and the average density is low. It is only on the productive and moderately fertile areas that population density is at all high.

Study Figure 2 carefully and note:

(*a*) The astonishing amount of the earth's surface that is unsuitable for dense settlement because of adverse climatic or topographic features.

(*b*) Many of the fertile lowlands lie towards the hearts of continents, as, for example, in Eurasia and North America.

SUBSISTENCE HUNTING AND FISHING

Hunting, fishing and gathering of wild fruits and nuts furnished food and a supply of the materials necessary for the simple needs of clothing and shelter for our earliest ancestors. However, when man learned to tame some of the animals which he hunted, and later to cultivate some of the plants, the importance of hunting and fishing gradually decreased until they were used only as a means of sport or to provide auxiliary food supplies.

To-day, certain less advanced people still depend principally on hunting, fishing and gathering for their livelihood. These migratory populations may be found scattered in small groups throughout regions that offer slight attraction to the more advanced peoples of the earth. As they exert little influence in the world, they interest us mainly because they afford illustrations of how man must have lived at earlier periods of time.

The Eskimos are an excellent example of such a people.

Habitat and environment of the Eskimos. Study Figure 3 to obtain some idea of the vastness of the area under discussion.

(*a*) The greater part of the marginal lands to the polar seas consists of lowland, but extensive plateaux are found in Greenland and Scandinavia and some

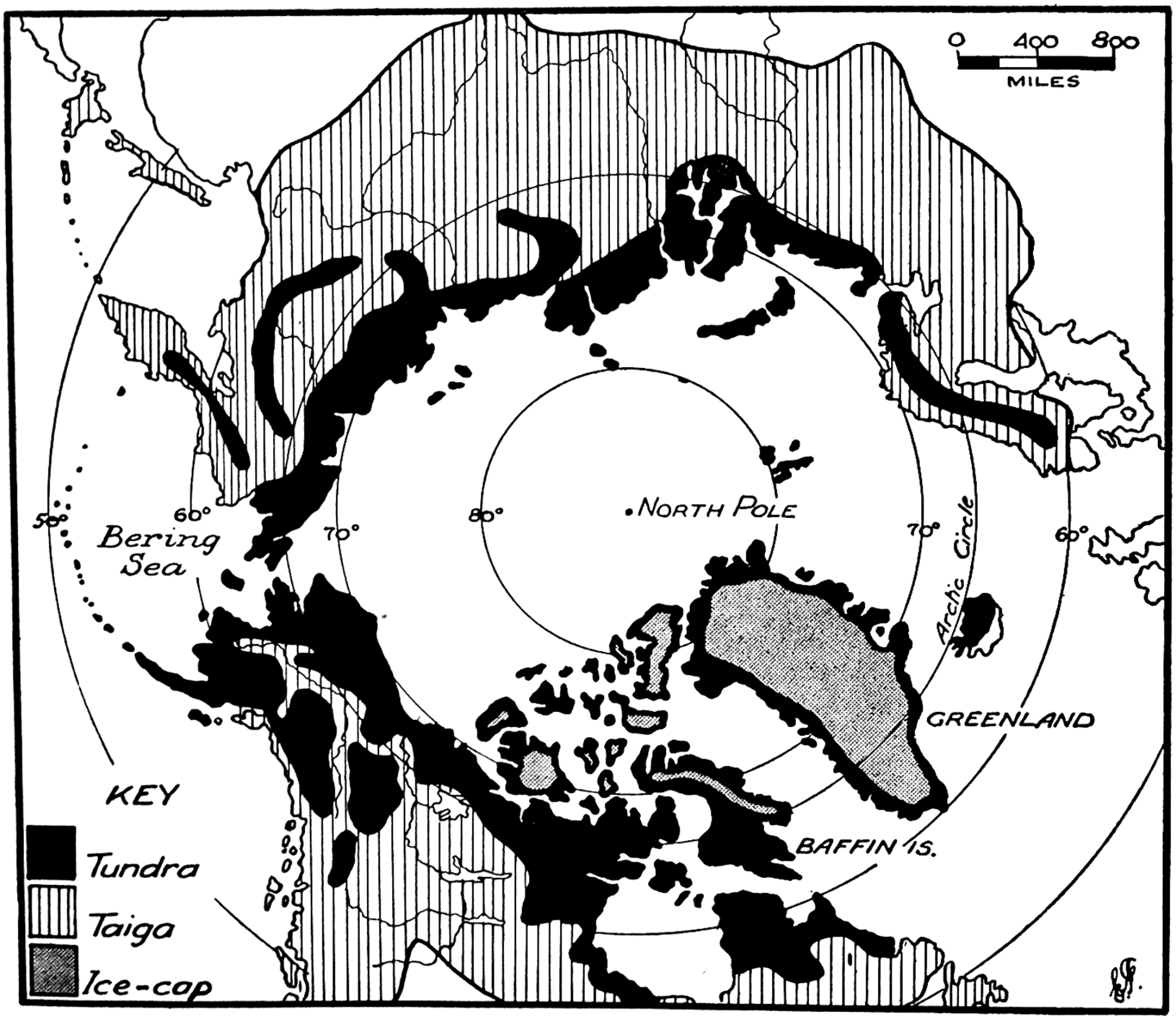

FIG. 3. The habitat of Arctic hunting and fishing peoples.

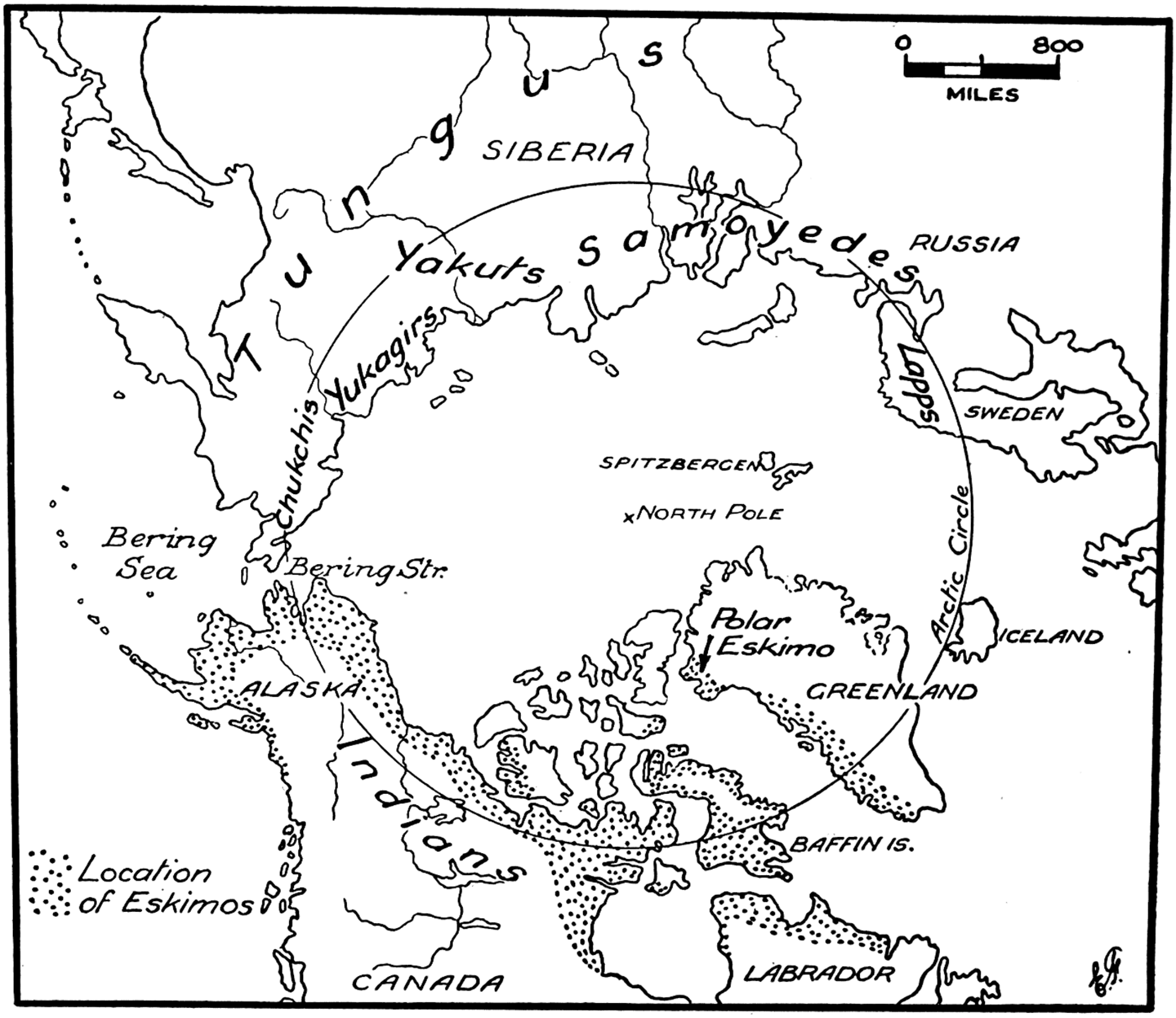

FIG. 4. Distribution of Eskimo hunters and fishers.

mountains occur in the Alaskan region and north-east Siberia.

(*b*) The climatic conditions are particularly hostile, as the dominant feature is the long, cold, dark winter, when the average temperatures fall to —30°F., or even lower, for short spells. The summers are rarely more than two or three months in length, with temperatures in the warmest month of some 50°F., though in warm spells readings of over 80°F. occur. Precipitation, mostly in the form of snow, is rarely over 10 inches a year, except where mountains are present.

(*c*) Under such conditions the soil temperatures are generally low, with the subsoil permanently frozen, so that the summer heat merely thaws out a few inches of surface soil, which become boggy because of the poor drainage.

(*d*) Trees cannot grow under these conditions, so that the principal vegetation is tundra grass, moss and lichens, which afford food for the large numbers of animals that roam the region in summer. Farther south, towards the taiga, dwarf trees appear, which in turn give way to the forests of pine, birch and fir of the taiga proper.

(*e*) These regions have considerable animal life, both on the land and in the water; and it is on these that the Eskimo and his fellow hunters in Siberia (Samoyedes, Yukagirs and Chukchis) depend for their existence. Of the land animals the reindeer is most significant in Siberia and Europe, while the caribou and musk-ox are important in North America. It is from the sea, however, that the Eskimo obtains most of his food, for these waters abound in fish (salmon), seals, walruses and white whales.

Figure 3 shows that the Eskimo peoples occupy a homeland that is as forbidding as any in the Arctic. In Greenland they are able to inhabit only small plains along the margin, for the land is rocky and barren and the interior is a huge ice-sheet incapable of supporting any life.

Yearly routine of these people. This is a direct reflection of their complete dependence on animal life and the full control of the environment on their lives.

In summer, they spread out over the seas in their kayaks, while the women and children fish for salmon in the streams on the land and catch birds in nets on long poles. Much food must be caught during this season and the autumn to provide reserves of food for themselves and their dogs during the winter.

In autumn, they move to the land with their dogs and sleds. They hunt the caribou moving towards their winter quarters in the forests. Large quantities of fish, seal and walrus are also caught and stored during this season.

In winter, considerable time is spent in their stone or driftwood houses, but seals and walruses are harpooned at their breathing holes in the shore ice floes. The musk-ox and polar bear are tracked to their hibernating lairs by the dogs and killed for meat. This is the hungry season among all these peoples, for rarely are they able to store or catch sufficient food to last them in plenty through the winter.

In spring, they move out to hunt the seal and walrus as they bask in the returning sun. Polar bears and musk-ox are stalked during this season.

With the coming of white whalers and fur-traders to this region, considerable changes occurred in the Eskimo life. They now use rifles for hunting as well as the spear and the bow and arrow. They trade furs for tools and amenities at the trading posts. So far contact with the whites does not seem to have decreased their numbers or seriously affected their mode of life. This is important, for if they are strictly conditioned by their environment, theirs is the only type of life continually possible in such conditions.

NOMADIC HERDING

Nomads are groups of people who wander in pursuit of their livelihood. They may or may not move on regular seasonal routes between neighbouring regions.

Pastoral nomads are concerned with following flocks and herds over areas where pasture is so limited as to permit only short stays in any one place. The family or tribe is the social unit and each tribe roams over the same area of country during each year. The limits of this grazing region have been established by usage over long periods and by agreement with neighbouring tribes.

These peoples are almost completely dependent on their animals for their livelihood. They use them as their main source of food (milk cheese and meat), clothing (from the skins and the wool and hair), dwellings (made from the skins or from felted wool and hair) and utensils (saddles, water-bags and drinking vessels from leather). Where possible, they supplement their food supplies by hunting what game there is in these arid lands, or by barter of rugs and leather goods for grain, dates and fruits in nearby agricultural or oasis market centres.

Distribution. Figure 5 shows the general location of the principal nomadic peoples of the world.

(*a*) Their domain stretches over a broad belt for some 7,000 miles from west Africa to east-central Asia.

(*b*) As Figure 7 shows, this is the area of mid-world deserts and semi deserts.

(*c*) These lands have in many cases been occupied by similar nomadic peoples from the earliest historical times.

(*d*) Nomadism is found in these regions to-day because they are economically unattractive to the com-

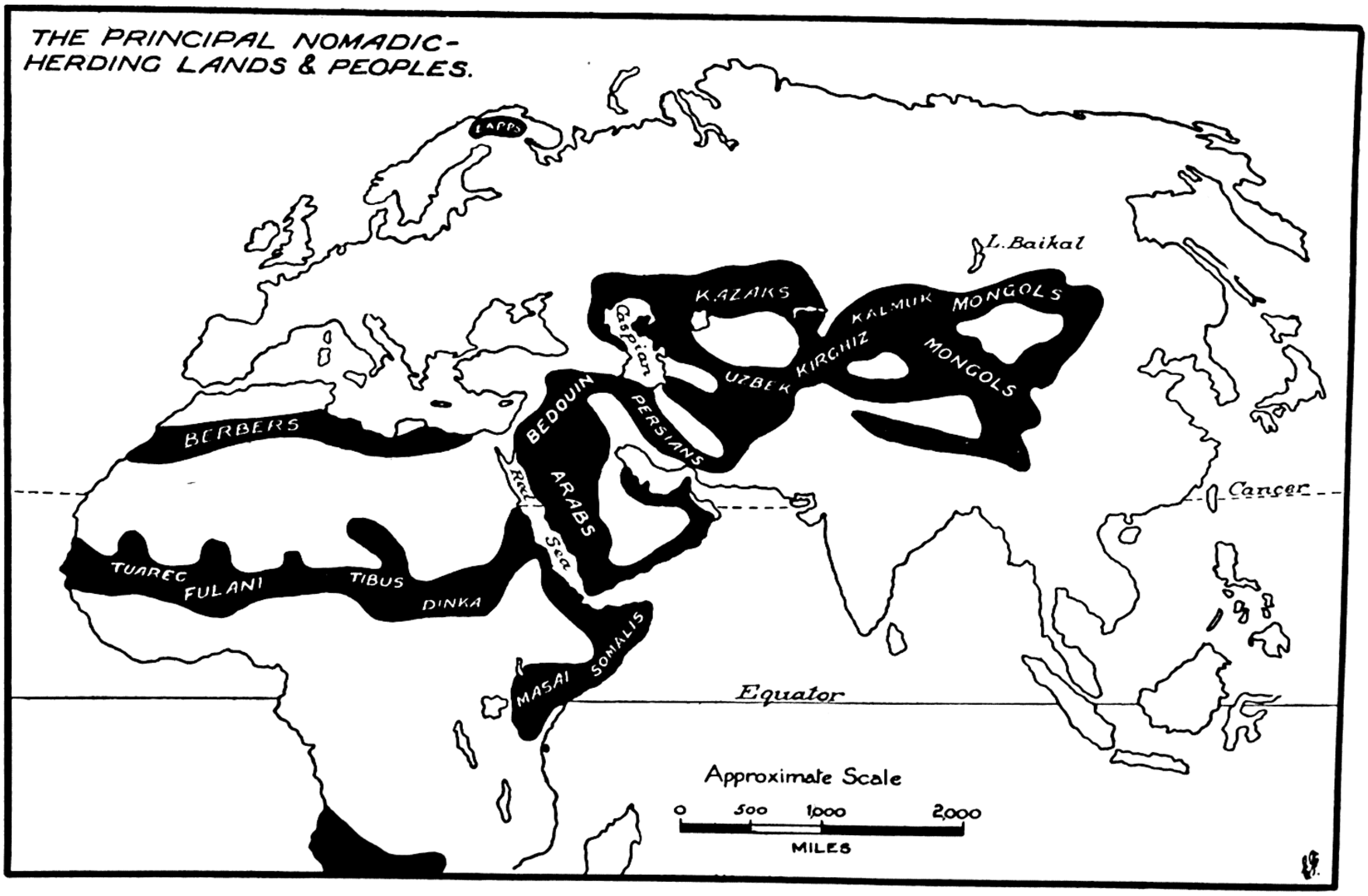

FIG. 5. The principal nomadic-herding lands and peoples.

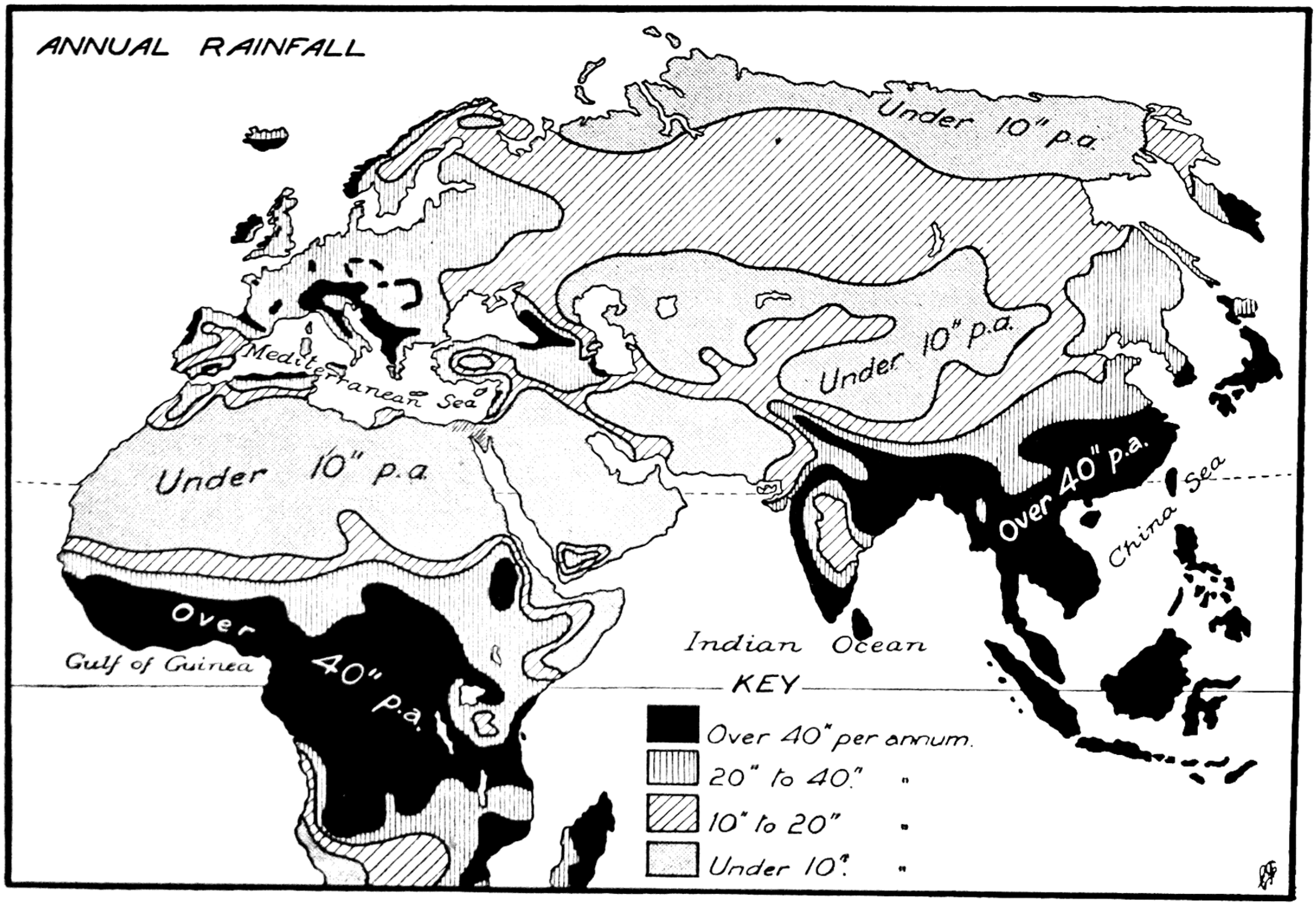

FIG. 6. The annual rainfall of Eurasia and North Africa.

mercial grazier or the agriculturist. In the Uzbek and Kazak territory of the U.S.S.R., the Government has been vigorously pursuing a policy of settling these nomads on irrigated farmlands so as to establish better political control over them. In Nigeria, the British Government has endeavoured to better the lot of the Fulani by teaching them something of animal breeding and helping them to establish agriculture in their lands.

Climate. Figure 6 shows some of the rainfall characteristics of the nomad region. The principal determinant of nomadic pastoral distribution is the low annual rainfall over the areas indicated. In Africa, Arabia and Iran an annual rainfall of under 10 inches results in true desert conditions, where the country is harsh and forbidding and covered with hardy scrub. Some ephemeral grasses and herbs grow immediately after the infrequent rainstorms. In central Asia, because of the generally cooler temperatures (resulting from higher latitudes and altitudes), a 10-inch annual rainfall results in semi-arid steppe vegetation and the true deserts occur only where the total rain is below eight inches.

An important feature is the seasonal distribution of the rain. In Africa, the rain advances from the Gulf of Guinea with the summer monsoons and penetrates, in decreasing amounts, far into the southern Sahara. The northern Sahara receives winter rains from the westerlies of the Mediteranean areas, as also does most of Arabia and the Middle East, as far east as the Mesopotamian lowlands. Nomads must follow the rains to obtain grass, so the season of movement differs in northern and southern Saharan lands. Central Asian rains occur mostly in spring and summer, being brought mainly by the monsoons from the Indian Ocean and the China Sea. Movement here therefore takes place essentially in summer and autumn.

In addition, the rains of practically all of these areas are usually of the thunderstorm type and therefore unreliable, both in their actual distribution and in the amount received from year to year.

A further significant climatic feature of the central Asian lands is the strong, biting winds of winter and spring. These have led to the general adoption of the circular yurt, made of inch-thick felt, as the chief dwelling of the nomad peoples there. By contrast, the African and Arabian nomads use tents without sides, so that they may have as much ventilation as possible in the very hot temperatures of these regions.

Vegetation. Figure 7 broadly summarizes vegetation features of nomad lands. In the African and central Asian regions it consists of a series of desert cores surrounded by marginal grasslands and woodlands, while in the sub-polar regions it is tundra.

It is in this feature that we have the basis of nomad existence. Tied as he is to his animals, he is forced to "follow the grass" (and water) wherever it may be. And it is this which gives the characteristic rhythm to his movements. In the dry season he is found in the grassland areas, where the higher rainfall assures him of grass and water. As the wet season rains move towards the desert cores, the nomad packs his easily moved dwelling and utensils and follows in their wake, often penetrating for 200 miles into the desert. When the wet season ends and the rains contract towards the marginal areas, the nomad retraces his steps, grazing the areas traversed on the outward movement. By the end of the wet season he is once more back in his dry-season pastures. It is while here that he barters and trades with the agricultural peoples who are found throughout the wetter portions of these marginal grassland-woodland areas.

In northern Europe and Asia is a belt of tundra vegetation which is the homeland of the herders of reindeer as well as the hunters and fishers noted in Chapter 2. The Lapps are perhaps the best known of these and they have a seasonal rhythm of movement with their animals very similar to those of the African and Asian nomads.

Central Asian nomadic herders. 1. Landforms (Figure 8). Stretching for 4,000 miles from east to west across the heart of Asia is the greatest grouping of plateau lands in the world. The various plateaux range from just under 2,000 feet to over 14,000 feet in height and each plateau lies at a different level from its neighbours. As each is fringed by bordering mountains and sierra-like ridges the general landscape pattern is one of a series of basins, mostly with internal drainage systems.

Figure 8 shows the great central portion of these plateau lands, and within it are several distinct levels. The highest lies in the south, where the Pamirs and the Tibetan Plateau average from 10,000 to 16,000 feet. North of the Kun-lun the basin of the Tarim

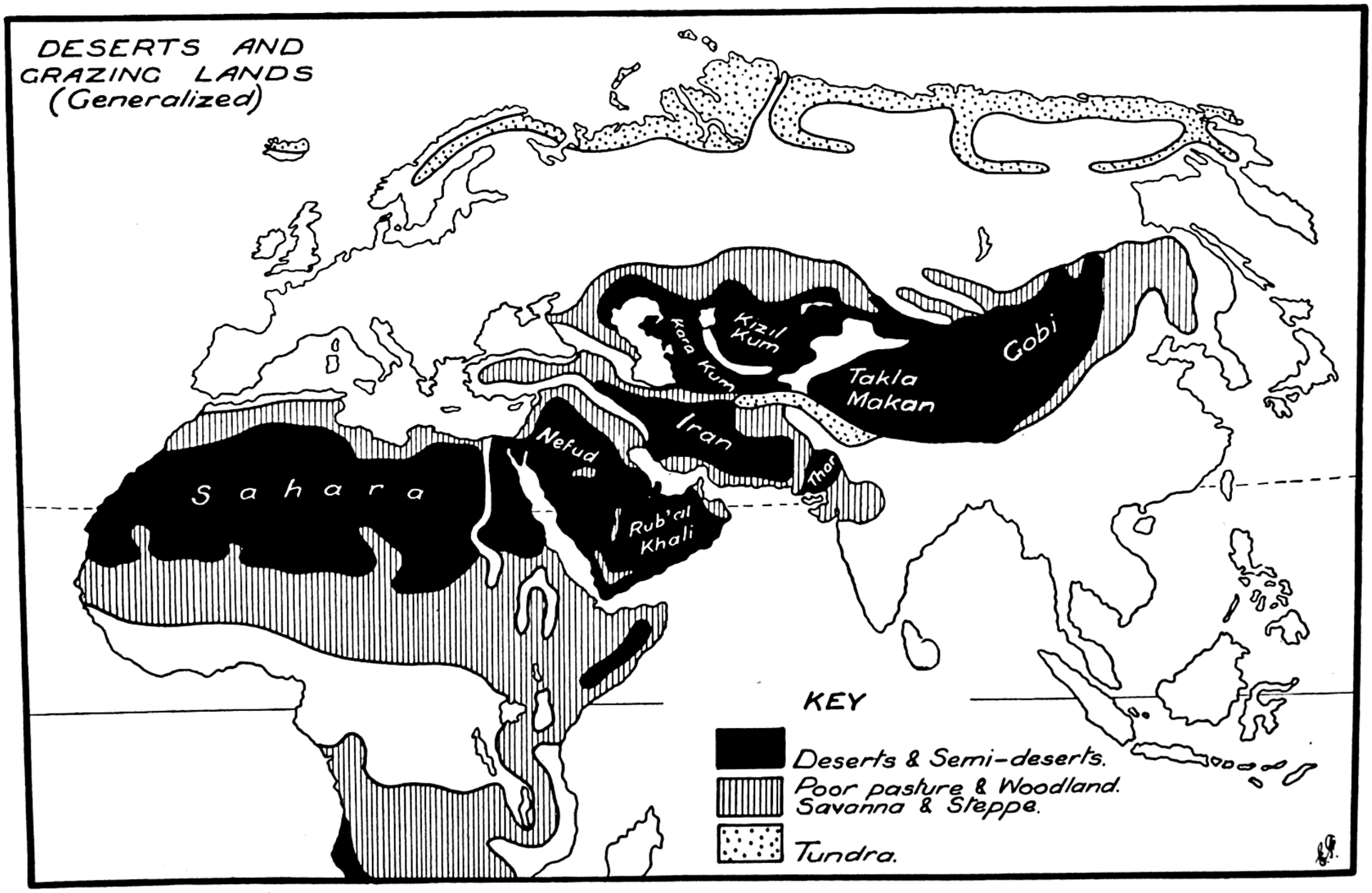

FIG. 7. Deserts and grazing lands of the mid-world areas.

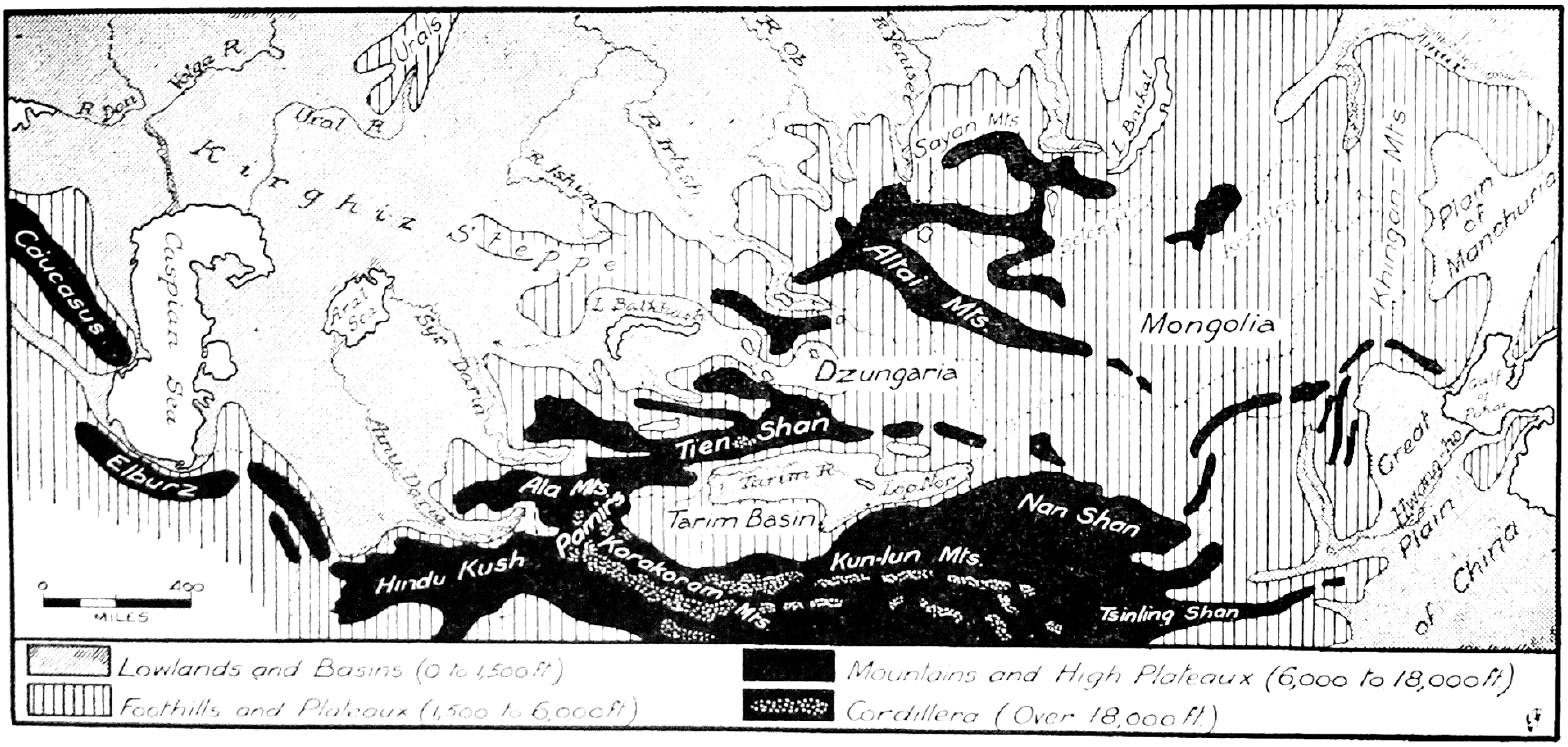

FIG. 8. The major landforms of the central Asian region.

River is about 2,000 feet in elevation, but in the eastern portion it sinks to 300 feet *below sea-level.* To the north of the Tien Shan is the Dzungarian basin, which is between 1,000 and 2,000 feet above sea-level. North-east of this again are the Altai-Sayan mountain masses with many small basin plateaux having an average height of some 2,000 feet. Eastward from these areas the broad Mongolian Plateau, with an average elevation of 5,000 feet, stretches almost to the Plain of Manchuria.

This general pattern of basin plateaux with snow-covered bordering mountains is significant in the

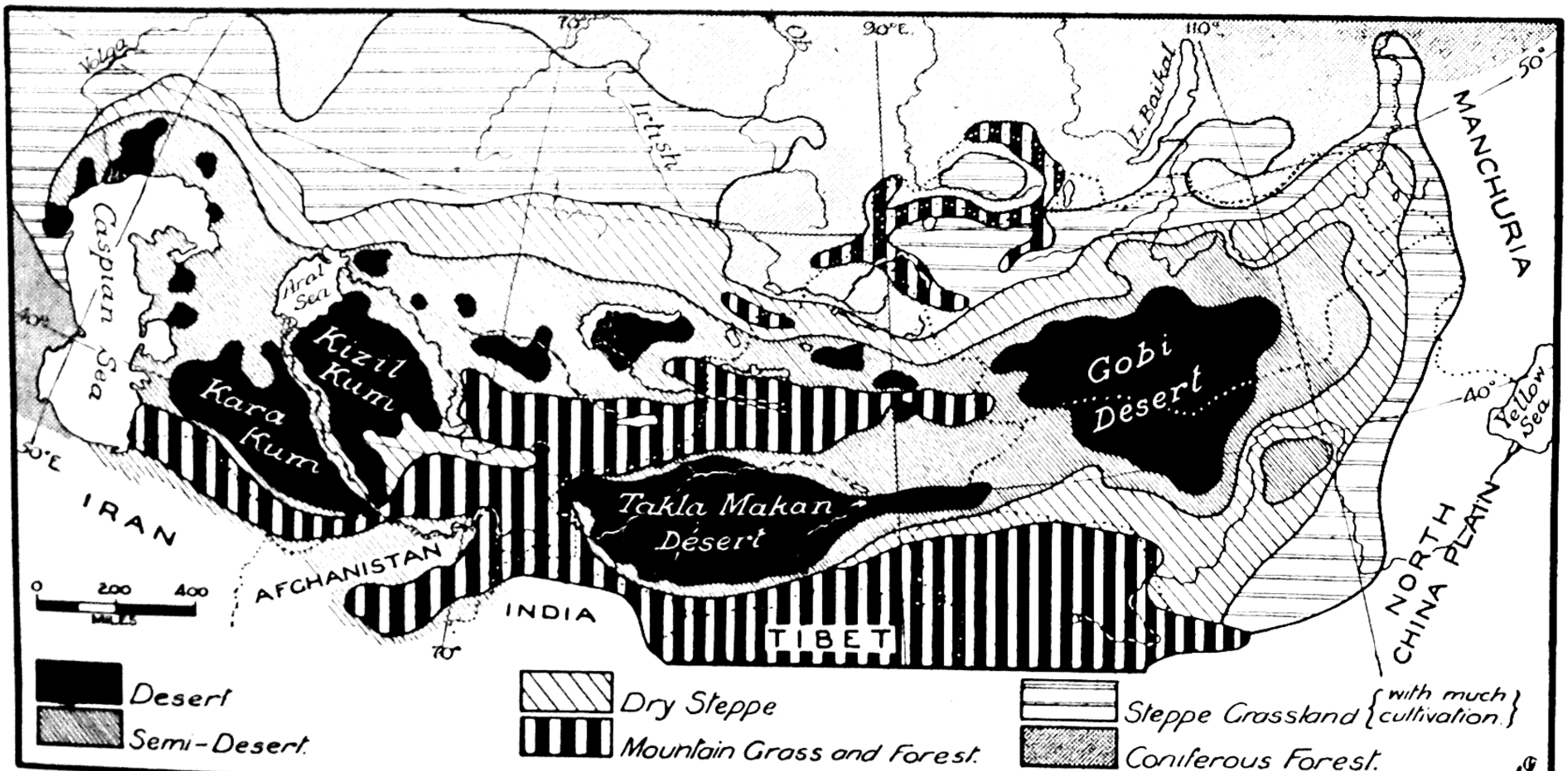

FIG. 9. Generalized vegetation zones of central Asia.

B

general economy of the nomadic herders who are the principal inhabitants of all these areas.

(*a*) Except for occasional irrigated farms along the lower mountain foothills, where water is available from the snow-fed streams before they lose themselves in the arid basins, these lands are unattractive to agriculturists and are left to the nomad and his herds.

(*b*) The mountain rims act as barriers to all rain-bearing winds and create areas of extreme aridity within the basins.

(*c*) The basin centres are too arid to be of any value even to the nomadic herders. This is particularly the case in the Lop Nor area and in central Mongolia.

(*d*) The nomad movement is mostly from sheltered winter quarters along the foothill valleys upwards to summer pastures, which lie in the Alpine meadow zones above the forest level of the middle slopes.

2. Generalized vegetation zones (Figure 9). Because of the many variations in landform types, climate and soils it is difficult to give a detailed and accurate picture of the plant types in a general map survey of this region. Figure 9 shows the broad pattern of the important groups, both in the mountain-plateau zone and in the bordering northern lowlands.

The general pattern is one of a series of desert cores surrounded by semi-desert shrub and grasslands, in which are many small desert areas. To the south and through the centre are large areas of mountain grass and forest, while northwards and eastwards the whole zone passes into steppe country, at first dry with good grazing herbage during the wet season, but changing to steppe proper as the higher rainfall areas are reached. These latter have been taken over by the agriculturists and now grow much wheat in the large Russo-Siberian area, and wheat, soy beans, and kaoliang in the Chinese section. The colder areas of central Siberia are covered with coniferous forests and are still largely undeveloped.

3. Sociology. Though all areas shown on the map (except the forests) were originally occupied by nomadic pastoralists the most important nomad zones to-day are those of the semi-desert and the mountain grass and forests.

A study of the yearly régime of the Kirghiz will best illustrate the use made of these areas by the various nomad inhabitants.

Figures 8 and 10 show that the Kirghiz occupy the basins adjoining the Tien Shan and the Pamirs.

The winter quarters of the tribes are strung out along the valley floors of the foothills. Often several tribes use the same valley area, where they inhabit permanent village quarters. The herds of sheep and goats are grazed on the dry herbage, which is often supplemented with small amounts of hay or grain grown near the village by that part of the tribe left behind during the summer migrations.

With the coming of spring rains a rapid migration takes place. During this period plant growth is slow and scanty, so that movement is constant and widespread over the interfluves of the lower mountain slopes.

By the end of May the rains are more regular. In addition, the summer warmth is melting the snows on the middle mountain slopes. Movement is now slower and moreover upwards through the timber belt (from 5,000 to 8,000 feet) towards the alpine meadow lands above 8,000 feet.

By mid-June these meadows are reached and the tribes are able to remain fairly stationary, with their tent encampments close to each other while their animals graze on the lush pastures. During this period the stock fatten on the rich grasses and the milk products are accumulated (usually in the form of cheese or koumiss).

Near the end of July the decreasing rainfall and gradual approach of cold weather forces the herders to start moving towards the lower ground. The movement is fairly slow as the summer pastures on the lower slopes are abundant and as yet ungrazed. In autumn, meat supplies are abundant because the surplus animals are killed off before the winter sets in.

By October the cold weather has set in and the nomad is once more established in his winter quarters in a sheltered valley.

This movement is regular in its seasonal rhythm and mostly over the same territory, for among these peoples there is a fairly accurate delineation of the tribal grazing boundaries. Such regular movements are known to geographers as transhumance.

Equipment is reduced to a minimum and shelters consist of a thick felt covering tied to a circular, dome-shaped frame made of willow (the yurt). The felt keeps out the cold winds of these high altitudes and the circular shape offers the least possible resistance to wind blasts from any quarter. The animals, including sheep and goats, are used as pack animals when the tribe is on the move. Food supplies are supplemented by hunting the game which abounds in the forest zones.

4. Tribal distribution and map summary of land use. Figure 10 is intended to be a reference map for locating the various nomadic peoples of central Asia. It should be read in conjunction with Figures 8 and 9.

Figure 11 summarizes the principal features of land use within the plateaux and mountains of central Asia.

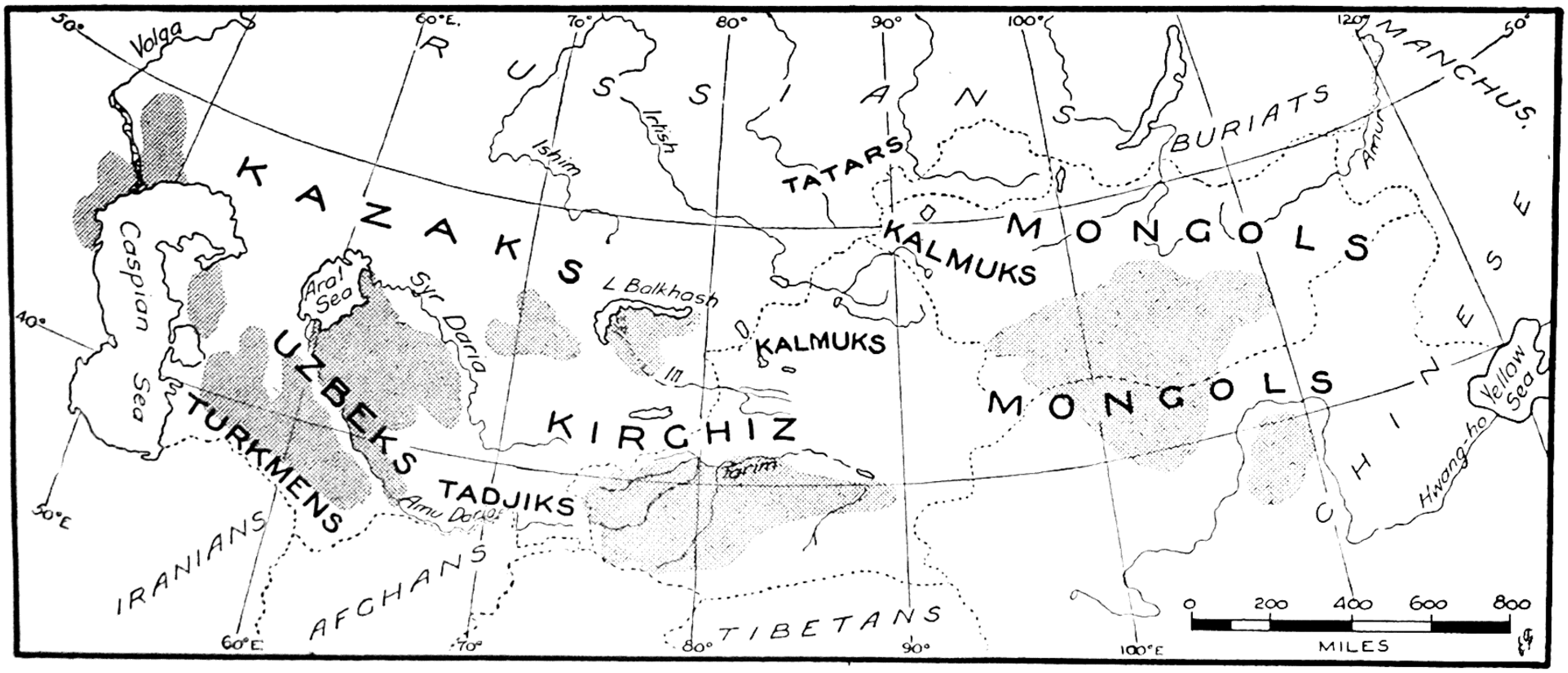

FIG. 10. The principal nomadic peoples of central Asia.

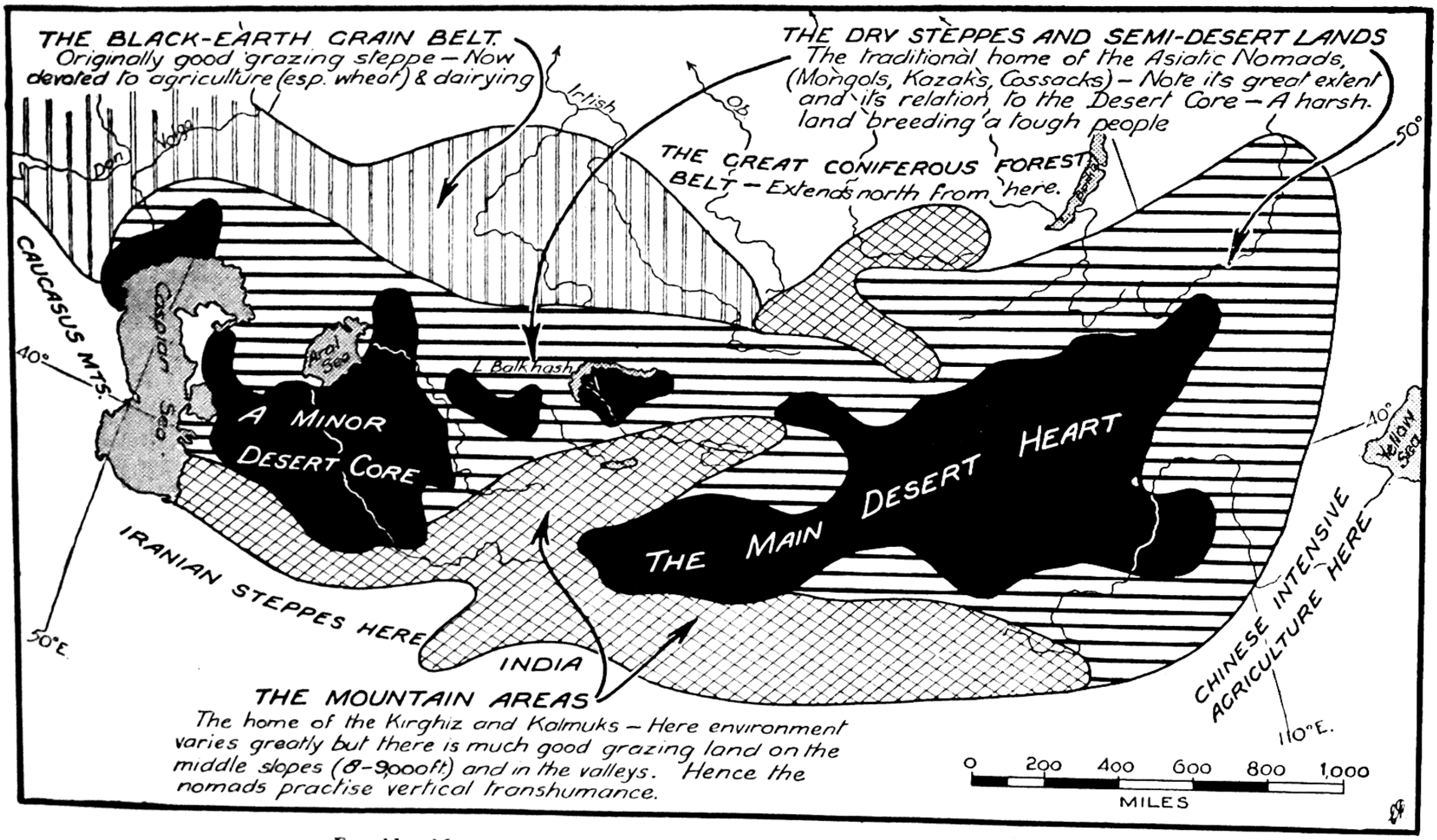

FIG. 11. Map summary of the main features of land use in central Asia.

5. Present pattern of human occupation in central Asia (Figure 12). The central portion of this huge area (the map covers approximately 6½ million square miles) is still occupied by nomadic herders. In the Soviet lands considerable changes have occurred since 1927, when the first five-year plan of the Soviet Government was instituted.

(*a*) In order to obtain better political control over the virile and independent nomads the Soviet has vigorously pushed forward with a twofold policy of land utilization in the Turkestan and Kazakhstan areas.

First, there has been a wide extension of the irrigated lands in Turkestan. This has been linked with a strong agricultural and educational policy among the Uzbek, Tadjik and Kirghiz peoples, with the result that large numbers of former nomads have become farmers on the irrigated areas along the Amu Daria and Syr Daria.

Secondly, to create a balanced economy in this newly developed area, the Government has pushed on with the full development of the mineral resources of coal, oil, copper and lead-zinc, together with a great development of hydro-electricity and industrial undertakings concerned mainly with oil refining, metal refining and the production of general consumer goods and agricultural machinery. As a result, the Turkestan area to-day shows a busy pattern of farming and industrial activities which is far removed from the leisurely backward nomadism of half a century ago.

(*b*) On the wheat-farming lands to the north of Kazakhstan collective farming methods have replaced the old individual farms of the peasants, and mechanization of farm practice is now widespread throughout this zone.

(*c*) Great industrial development has occurred in western, central and eastern Siberia, and to-day there are three great industrial regions:

(*i*) in the southern Urals, with the huge steel centre of Magnitogorsk as its nucleus;

(*ii*) in the Kuznetsk area, where the enormously rich coal deposits have been developed to support the steel plants of Stalinsk and the general manufacturing and heavy industry plants of Novo-Sibirsk. This coal is used also at Magnitogorsk some 1,200 miles away, with the trains back-loading iron-ore for the Stalinsk plants.

(*iii*) in the trans-Baikal area, where exploitation of minerals has resulted in the growth of new industrial centres at Irkutsk and Chita.

(*d*) Changes have occurred also in Manchuria, where the Japanese pursued a vigorous industrial development policy during the 1930s. The hub of this development was the Fushan coalfields, east of Moukden. Huge steel plants and heavy industry undertakings were established in Moukden and nearby centres.

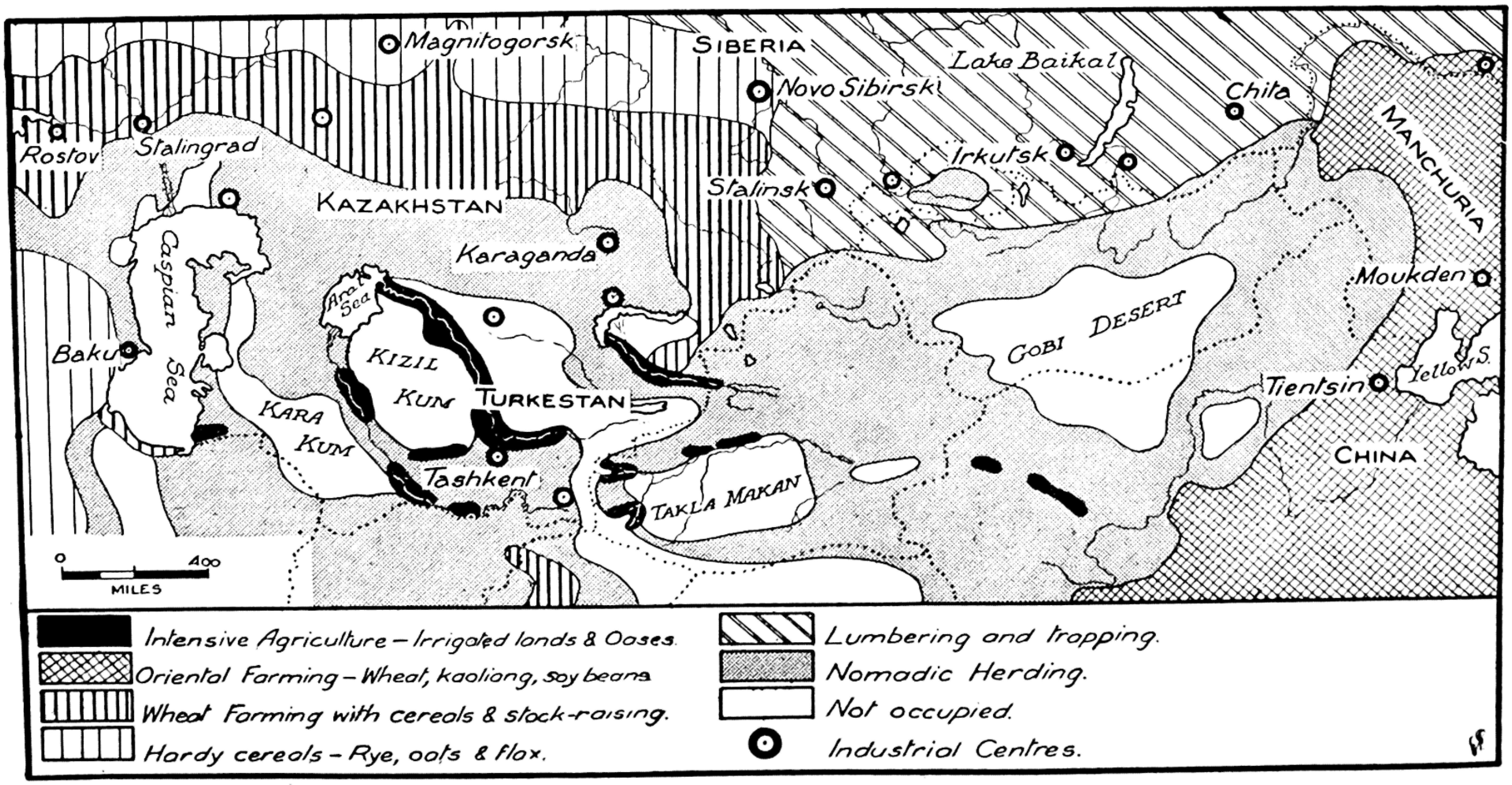

FIG. 12. The pattern of present-day human occupancy of central Asia.

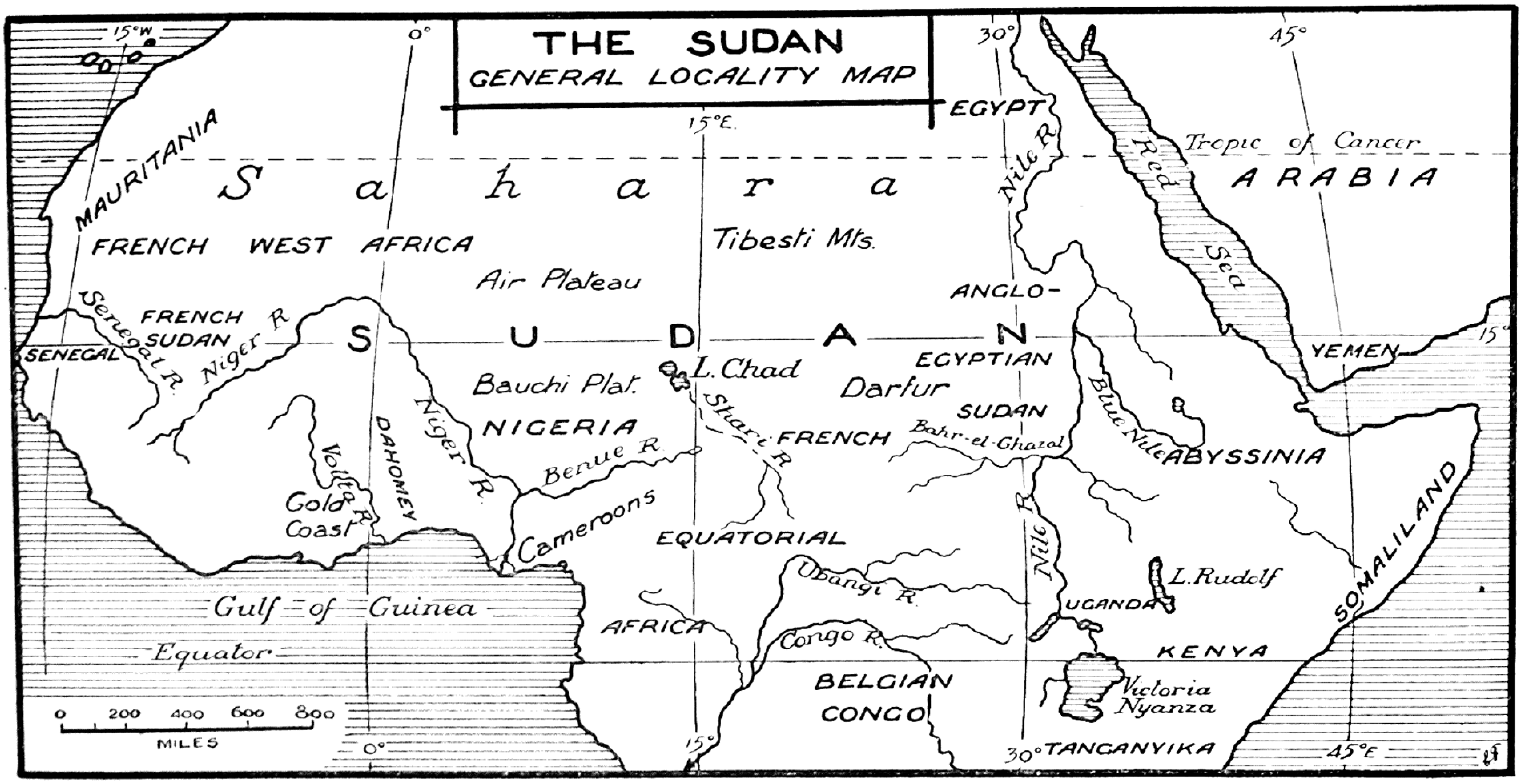

FIG. 13. Locality map of the Sudan region of Africa.

(*e*) China, too, has seen the introduction of modern industry. Tientsin is now an important industrial and trading centre for the north China region.

It should be noted that, except for Turkestan, where abundant minerals and a good water supply aided a more intensive and advanced use of the land, the nomad heart of the region has not experienced any great change in its age-old mode of living. It offers too few inducements and presents too many difficulties to be attractive to either the agriculturist or the industrialist.

Nomads of the Sudan. 1. General considerations (Figure 13). The Sudan stretches for over 4,000 miles across Africa between the Sahara and the equatorial regions. It affords an example of a well-known geographical region whose actual boundaries are very vaguely defined.

The map shows also the various State and physical place names of the Sudan area.

Figure 14 shows first, the savanna grassland area which, north of the equator, is usually regarded as forming the Sudan. Secondly, it indicates the general distribution of the major language and racial groups of people who are either wholly or partly nomadic herders.

Figure 15 summarizes the major landform types occurring throughout the Sudan and the adjoining areas. Confining the discussion of these to the Sudan and Saharan areas it may be noted that:

(*a*) Much of the region is low plateau with an elevation between 1,000 and 3,000 feet, trenched by broad river valleys such as the Niger-Benue and the Upper Nile systems. This plateau drops away sharply with steep, eroded scarps towards narrow coastal plains, but it has a general uniformity of surface, though this is interrupted by upland regions of considerable ruggedness. These higher portions are mostly the eroded sections of the High Plateau, which continues south of the equator to form the major landform there.

(*b*) In the central Sahara, the Ahaggar and Tibesti mountains represent an eroded High Plateau remnant of ancient pre-Cambrian rocks capped by recent volcanic lavas. They have an average height of 5,000 feet in the Ahaggar area, and 7,000 feet in the Tibesti section, with peaks rising to 10,000 feet in the Ahaggar and over 11,000 feet in the Tibesti.

(*c*) The Darfur Uplands, separating the Nile and Chad drainage systems, are portion of the middle tongue of the High Plateau and have an elevation of some 6,000 feet with one volcanic peak rising to 10,600 feet.

(*d*) The Abyssinian Highlands represent a very severely dissected portion of the High Plateau (they lie in a high rainfall region). Their average elevation is over 7,000 feet; but many lava-capped peaks rise above 11,000 feet. The eastward extension into Somaliland is somewhat lower, about 4,000 feet.

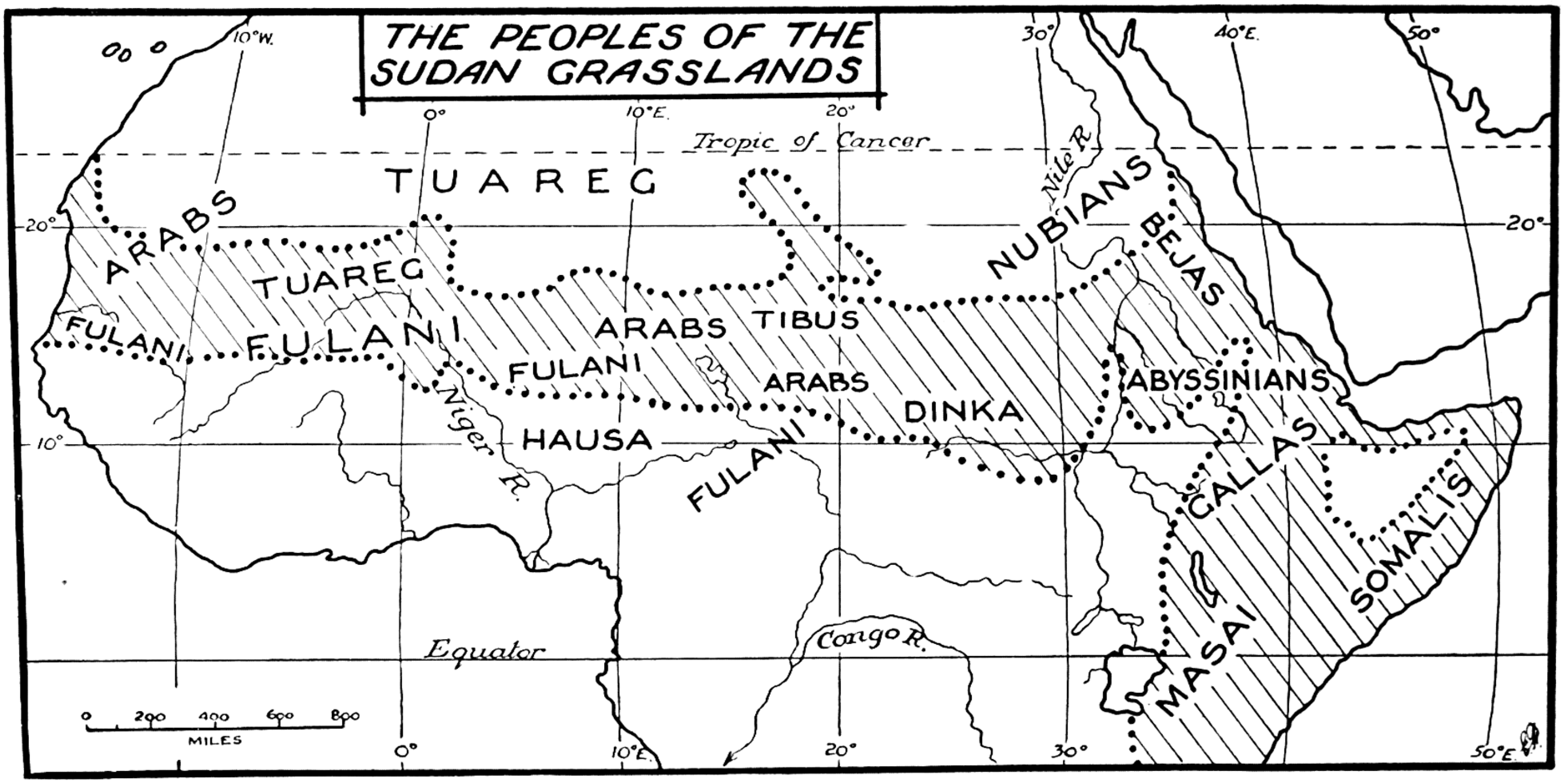

FIG. 14. The peoples of the Sudan grasslands.

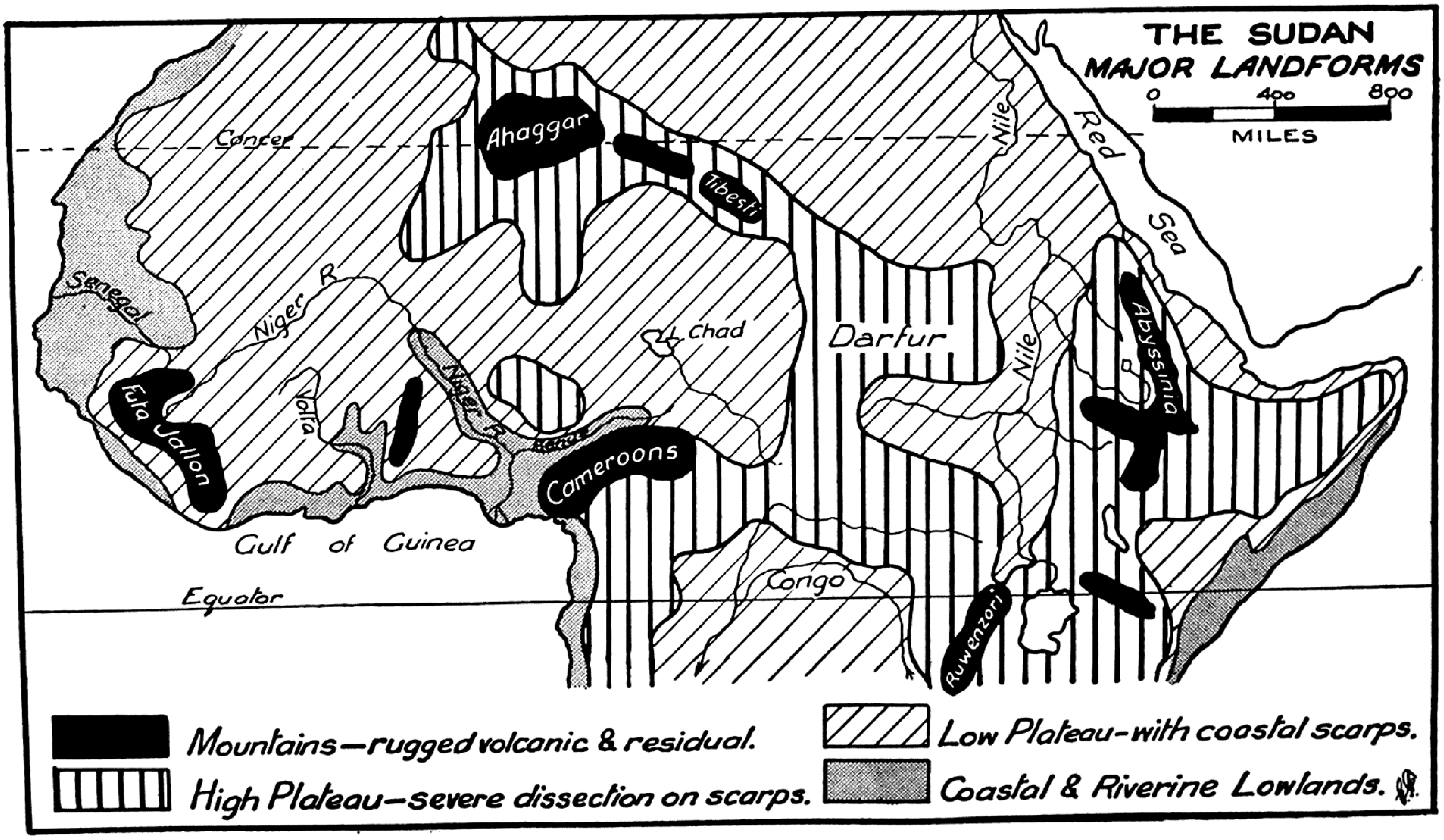

FIG. 15. Landforms of the Sudan area.

2. **Climate of the Sudan lands.** (a) **Temperature.** The latitudinal position of these lands ensures generally high temperatures throughout the year. Summers are excessively hot, with average readings over 90°F., while the cooler season has averages of about 70°F. Because of the generally cloudless skies of these inland areas radiation is rapid after sunset and the nights are usually cool—often as much as 30°F. cooler than the days. On the highland areas near-frost temperatures are quite common at night.

(*b*) **Rainfall (Figure 6).** The Sudan and Saharan marginal lands are characterized by a moderate rainfall. Reference to Figure 16 will show that north of 10°N. latitude the isohyets run east and west and the decrease in annual rainfall is fairly rapid from the coast inland.

The rain throughout the whole of the Sudan comes from summer monsoon winds, which advance northwards with the high-sun rays towards midsummer (July), and retreat during the autumn. There is thus a regular seasonal rhythm of rain and drought, which governs the general movement of the nomad pastoralist and his herds of cattle and goats. The rainy season decreases in length from seven months in latitude 10°N. to less than three months at latitude 18°N. The Saharan region receives only intermittent and irregular storm rains.

On the east much the same seasonal monsoon pattern exists to give similar annual totals and similar length to the rainy season, except in Abyssinia (Ethiopia) where the high mountains cause a much greater precipitation (over 40 inches a year).

3. **Vegetation.** Figure 16 shows the general pattern of vegetation types throughout central Africa and the Sudan. The main factor controlling the distribution of vegetation is the rainfall, and since the rainfall decreases from south to north throughout the Sudan the main belts of vegetation are approximately latitudinal, running from west to east. Not only the total annual rainfall, but also its seasonal distribution is important in controlling the distribution of plant communities. There is a clear correlation between the length and intensity of the dry seasons and the plant zonation.

(*a*) Under optimum conditions of constant heat, and high yearly rainfalls with no dry season along much of the Guinea coast and in the Congo basin, dense, high, evergreen forests develop.

(*b*) About 150 miles inland the annual total of

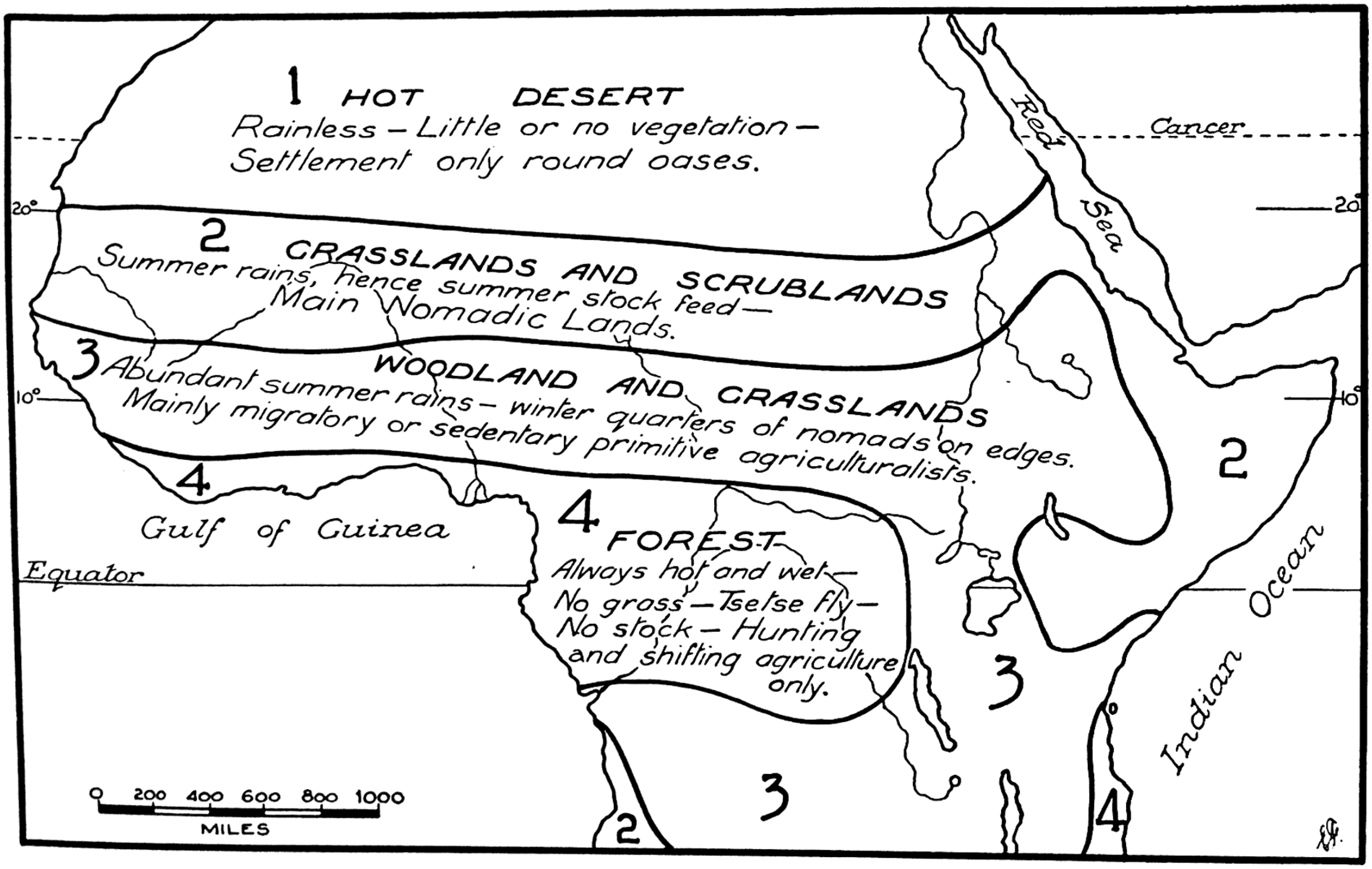

FIG. 16. Map summary of vegetation zones and general land use in central Africa and the Sudan.

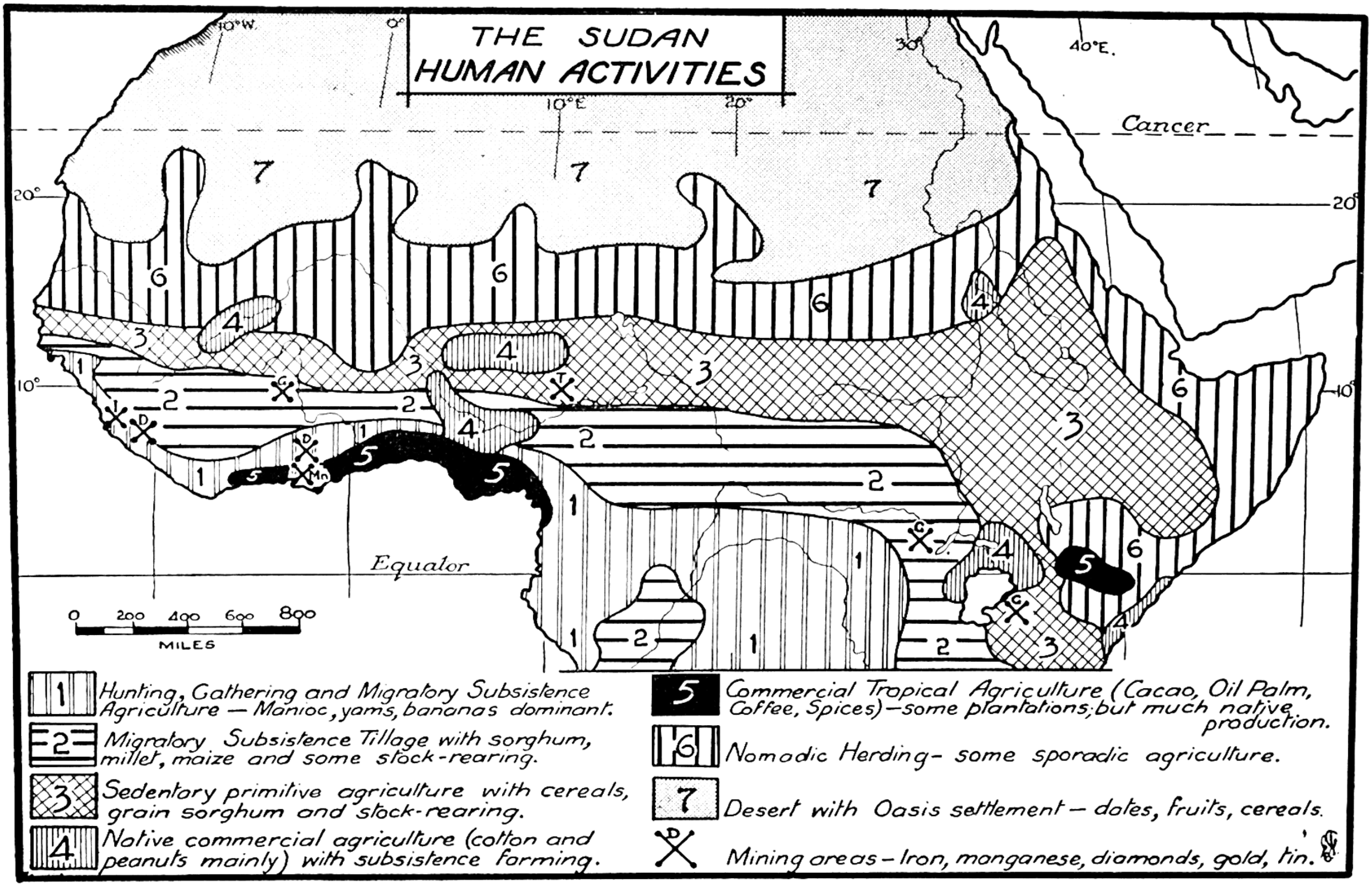

FIG. 17. Summary of human activities in the Sudan area.

rain decreases to about 60 inches, while there is a partially dry season of about three months' duration. Under these conditions the rain forests give way to woodlands of tall trees, but spaced sufficiently far apart in places to allow for some grass growth. The grasses here are often eight feet high.

(*c*) From 10° to 15° latitude, where the annual total of rain drops to between 20 and 40 inches and the dry season is from five to seven months in length, the woodland becomes more stunted and open in character and the grassy areas more extensive. This is true savanna-woodland with clumps of umbrella-like trees, about 40 feet high, scattered over vast grassy plains covered with five-foot to six-foot grasses in the wet season. In the dry seasons the whole country is sere and yellow, and the trees shed most of their leaves.

(*d*) Between 15° and 18° latitude the vegetation changes to xerophytic (dry-living) types consisting principally of scrubland and thornland with shorter and more scattered grasses. Here the rainy season is only three or four months in length and the annual total is under 20 inches. This is the main habitat of the nomad pastoralists who advance from this area out into the southern Saharan zone to use the pastures there during the short summer rain period.

(*e*) North of this zone lies the great desert, which has a bordering area receiving sufficient rain (about five inches) during the two to three months' summer rainy season to grow a fairly good coverage of annual grasses and ephemeral herbage.

4. **Human activities in the Sudan and adjoining lands.** Figure 17 shows the general pattern of the major form of human activity throughout the whole of central Africa. It summarizes the various geographical factors noted in Figures 14 to 16.

The influence of climate on the subsistence activities of the native peoples is at once apparent, since the major areas follow the latitudinal zoning of the rainfall map (Figure 16). Thus there is migratory subsistence tillage supplemented by hunting in the high-rainfall forest and woodland areas. This is fringed by primitive sedentary agriculture on the better watered savanna areas, which gives way to nomadic herding in the poorer savannas and desert margins.

In order to understand the sociology and yearly routine of the pastoral nomads of this region, a brief study will be made of the Fulani.

Figure 14 shows that they inhabit the middle Niger lands and the Chad basin.

They are akin to the Gallas of Abyssinia, and are a

distinctly white race—straight-haired, straight-nosed, thin-lipped, long-headed and of slender physique, though their skin colour to-day varies from reddish-brown to black. They appear always to have been herdsmen and have a long history of nomadism, which is nowhere better shown than in their feeling that agriculture is a despicable occupation, fit only for slaves.

The Fulani are organized into tribal groups in which there are four main classes—nobles, marabouts (warriors), artisans and slaves. The pattern and spirit of their society resembles feudalism in that it is based on birth, property rights and duties to a chieftain.

In the cool season they graze their stock in the better portions of the grasslands, usually near permanent water, where most of them have some land under cultivation by slaves for grain crops for food and fodder. As the summer approaches they move to the poorer grasslands, where the storm rains grow a scanty herbage. In most cases they plant a crop before their departure, to be harvested on their return. This movement is usually over a fixed area of territory, as each tribe has established the boundaries of its own particular territory and any encroachment by other tribes results in war. The whole of this large area (often 200 miles by 30 miles) is occupied in the course of the period of movement forwards and backwards, as the paucity of the feed forces almost continuous movement of these people.

Their dwellings are of two types. In the winter village the houses are made of sun-dried bricks or of pisé, thatched with straw. When on the move their tents are made of skins or of rough cloth, stretched over a light wooden frame—remarkably similar to the yurt of the Kirghiz.

Finally, the map shows something of the penetration of Europeans into these lands, with the areas marked as either mining or commercial tropical plantations; also of the development of commercial agriculture among the native peoples (see number 4 area on Figure 17).

Nomadic herding in Arabia. Environment. Figure 18

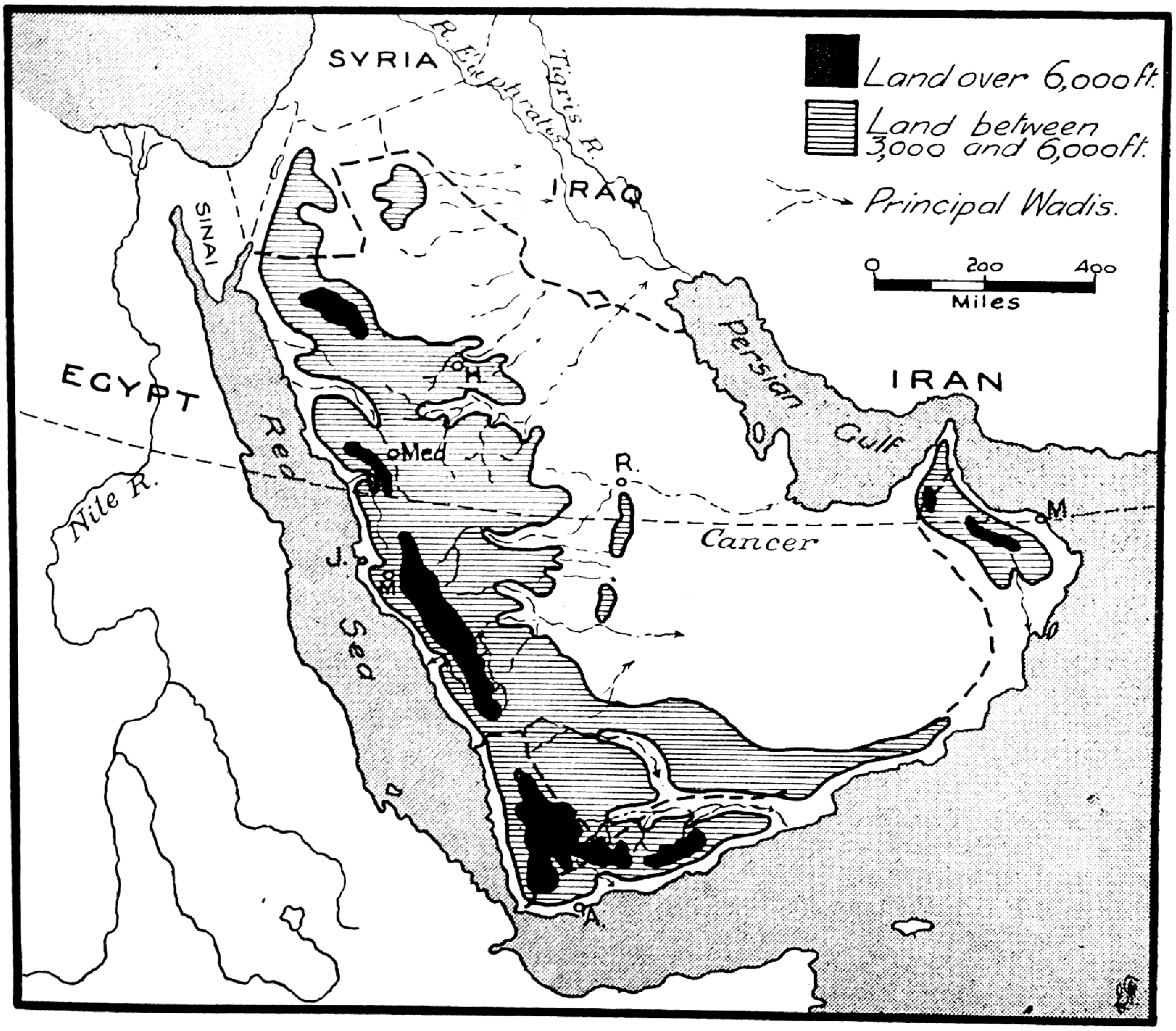

FIG. 18. Landforms of Arabia.

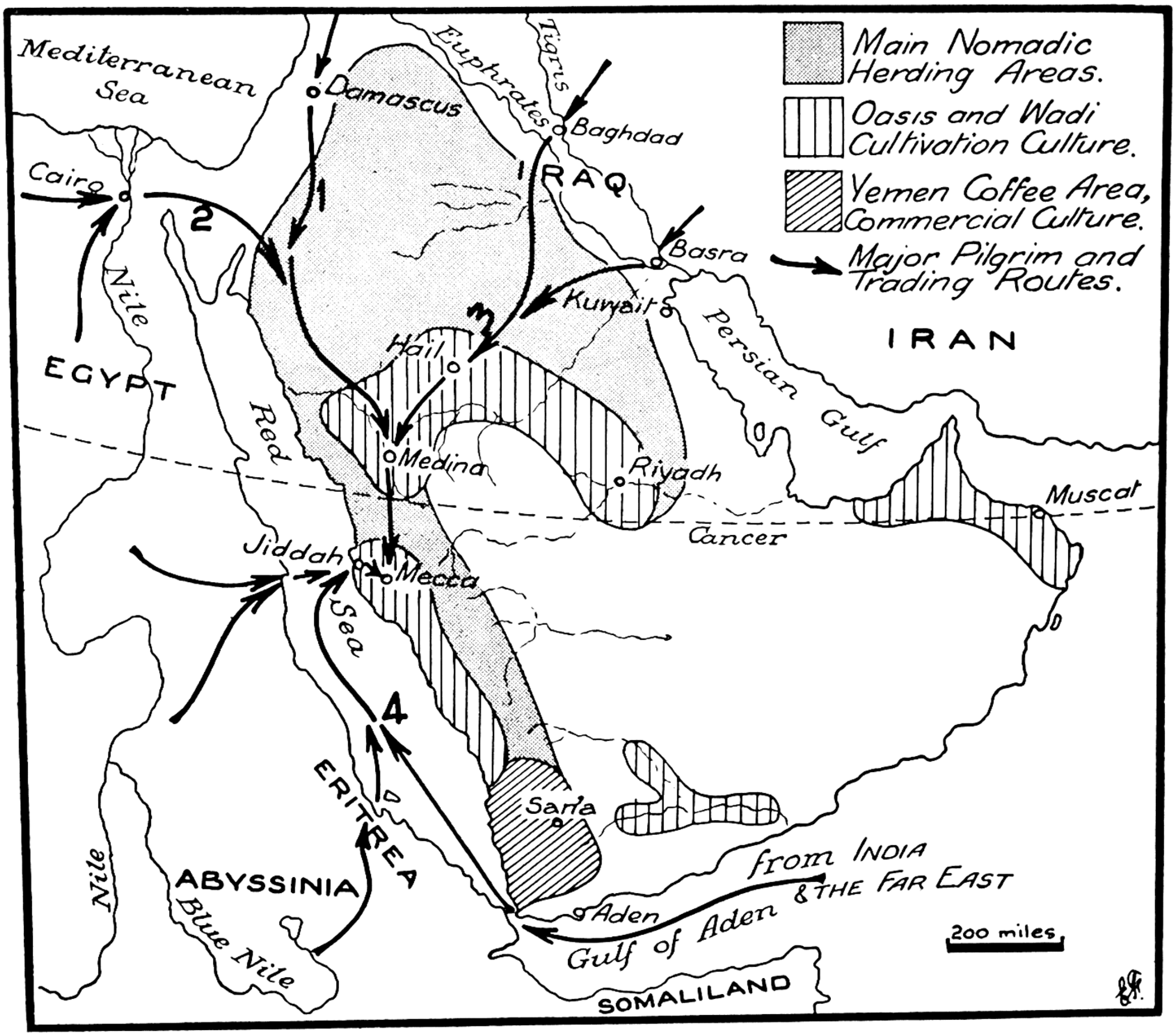

FIG. 19. Map depicting sociology of Arabia.

shows that Arabia is a large rectangular peninsula about 800 miles wide and 1,200 miles long, with an approximate area of one million square miles. It consists of a great plateau block tilted from the west to the east and bordered on the Red Sea side by steep scarps topped by ancient volcanic piles rising to 8,000 feet. The entance to the country on this side is by way of steep valley routes and difficult passes. The interior surface is similar to that of the Sahara and is made up of hamada, or wind-swept rocky pavements in the north; erg, or sand dunes in the south, south-east and parts of the centre, and serir, or flat dusty regions over most of the remainder of the country. There are no perennial rivers but, as Figure 18 shows, a series of wadis (dry water courses) run across the plateau towards the Persian Gulf and Iraq. They are shallow and water may be found in them by digging, while occasionally a string of waterholes form oases in the valleys. Hence they afford the main lines of movement throughout the country as well as being foci of settlement.

Climate. Apart from Yemen, Arabia is a land of arid and semi-arid climates with very hot days and cool to cold nights, due to its elevation and cloudless skies. Much of the interior is almost rainless (see Figure 6) but Yemen receives from 15 to 25 inches from summer monsoons, and northern Arabia gets small amounts of regular winter rains from the Mediterranean. The interior mountains receive occasional rain from storms and these are often of great intensity.

Sociology. In such an environment grazing and animal husbandry are important. The sparse pastures resulting from the rains are utilized by large numbers of Arabs as grazing for their camels, asses, goats and horses. As with the Asian nomads, milk foods form the basis of the diet, being at times supplemented by dates, fruits and grains bartered from the oasis-dwelling agriculturists. Their clothes are generally woven from

wool or hair and consist principally of the burnous (hooded cloak) which is long and flowing to keep out the sand and heat of the day and to act as a suitable covering during the cold of the nights.

Because they have to move frequently and quickly, their tents consist of a long strip of mohair cloth supported on poles and simply subdivided into two compartments, one for the men and one for the women. The saddle cloth and carpets form the floor covering.

The Arab nomads are a hardy and intelligent people of an independent nature. They are antagonistic towards any centralized government and prefer a union of several families forming a clan with a chieftain at its head. As a result outside political control of these people has always been difficult and to stable agricultural peoples the nomads are unruly peoples who are to be feared because of their pillaging raids.

Figure 19 illustrates another aspect of the Arabian scene. Here may be seen the significance of the country as the centre of the Mohammedan world. This lends special importance to the region. To visit the holy cities of Mecca and Medina, the pilgrims move in thousands along the four main routes indicated. Such a movement each year results in trading activity along the routes and in the exchange of ideas among these peoples and the native Arabs.

Figure 20 is a synoptic view of land use in Arabia. As well as the nomad region of the north you should note the oasis groups in the centre and west, where cultivation is of some importance, and the oil-fields of the east. These have had a profound effect on the lives of all Arabs and have been the means of bringing sudden wealth to the country. Just what effects this wealth will have on a normally frugal and poor people is difficult to foresee. On this map also is indicated the great importance of Yemen, with its better rainfall and its irrigation farming, resulting in a concentration of approximately half the population within this small area.

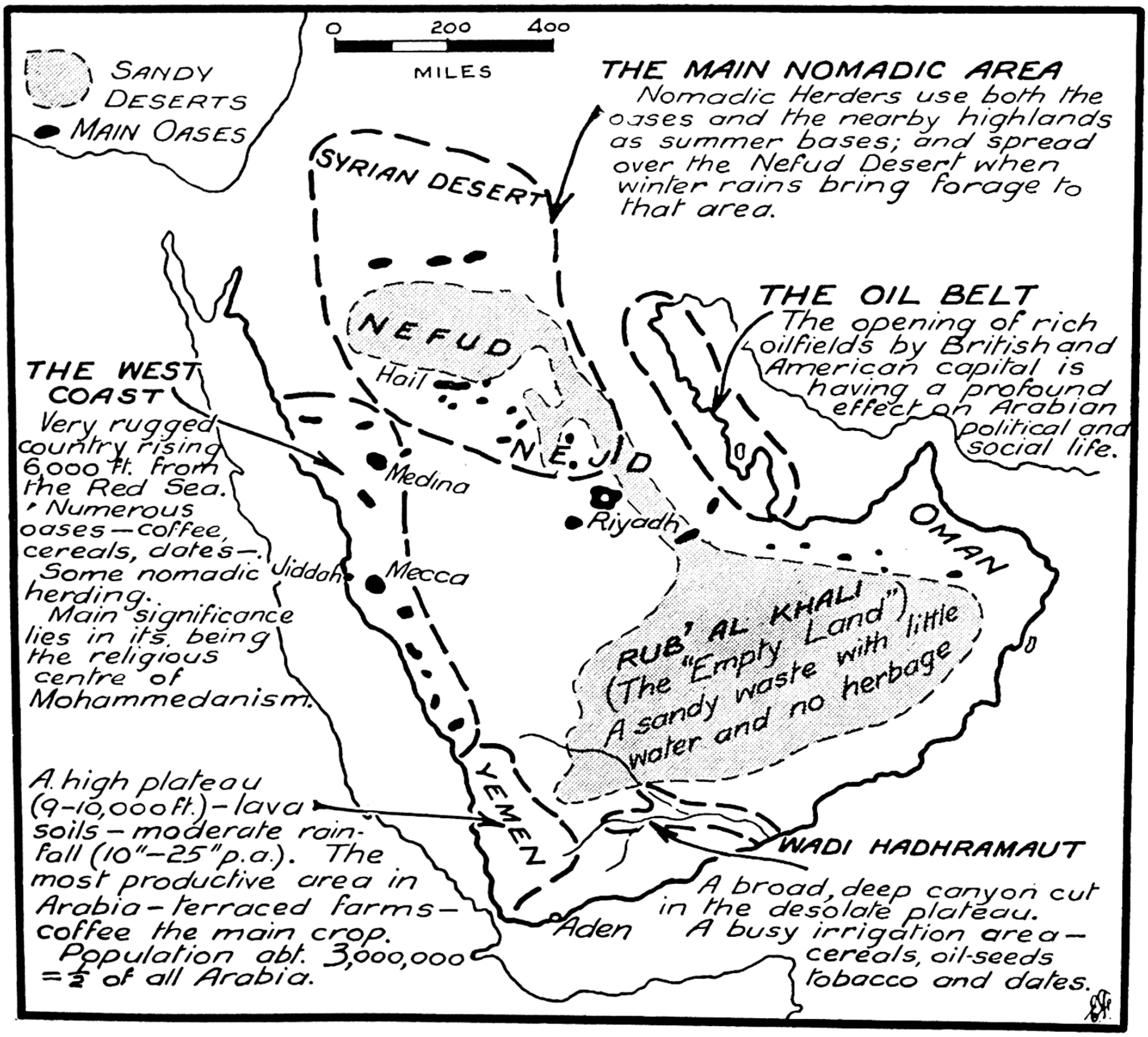

FIG. 20. Map summary of land occupancy in Arabia.

4

SUBSISTENCE AGRICULTURE

Figure 1 on page 2 showed the approximate distribution of subsistence agriculture in relation to other forms of land use throughout the world. The text on page 4 indicated that in this form of land utilization the aim of the farmer is to produce sufficient food for himself and family. It was also noted that while doing this the majority of subsistence farmers endeavour to produce small surpluses of farm produce, either to exchange in the local market town for foodstuffs they are short of, or to sell to traders in order to obtain some money with which to purchase simple tools and articles of household equipment that would be beyond the power of the farmer to make for himself.

In Figure 21 may be seen a more accurate distributional pattern of subsistence agriculture and a more exact subdivision into types. The four kinds of agriculture shown on the key may be reclassified into two main types, viz: (*i*) migratory primitive agriculture; (*ii*) sedentary agriculture which includes (*a*) sedentary primitive agriculture (*b*) oriental subsistence farming and (*c*) occidental subsistence farming. With the exception of oriental subsistence farming, all of these agricultural practices are found either among the more backward peoples in the lands where they occur, or in geographically difficult regions, where mountain landforms, swampy lowlands or excessive heat and moisture create natural handicaps. Thus in the Congo basin, West African coastlands and the Amazon valley the combination of constant high temperatures and heavy annual rainfall results in such a vigorous forest growth and such rapid impoverishment of the soils by leaching when the forests are cleared as to make farming an arduous and usually unprofitable undertaking. In the East Indies and mountain areas of Indo-China, Siam and Burma the added feature of rugged topography has resulted in the peoples there remaining in a backward farming condition, while their more favoured lowland neighbours have developed one of the most advanced farming techniques in the world.

The occidental subsistence farming areas of Europe and the United States occur either among isolated groups of people, as with the hill-billies of the United States, or among educationally backward peoples as in Poland and south-east Europe. In both these cases the present farming practice is a relic of the mediaeval "domestic" system of land use and is

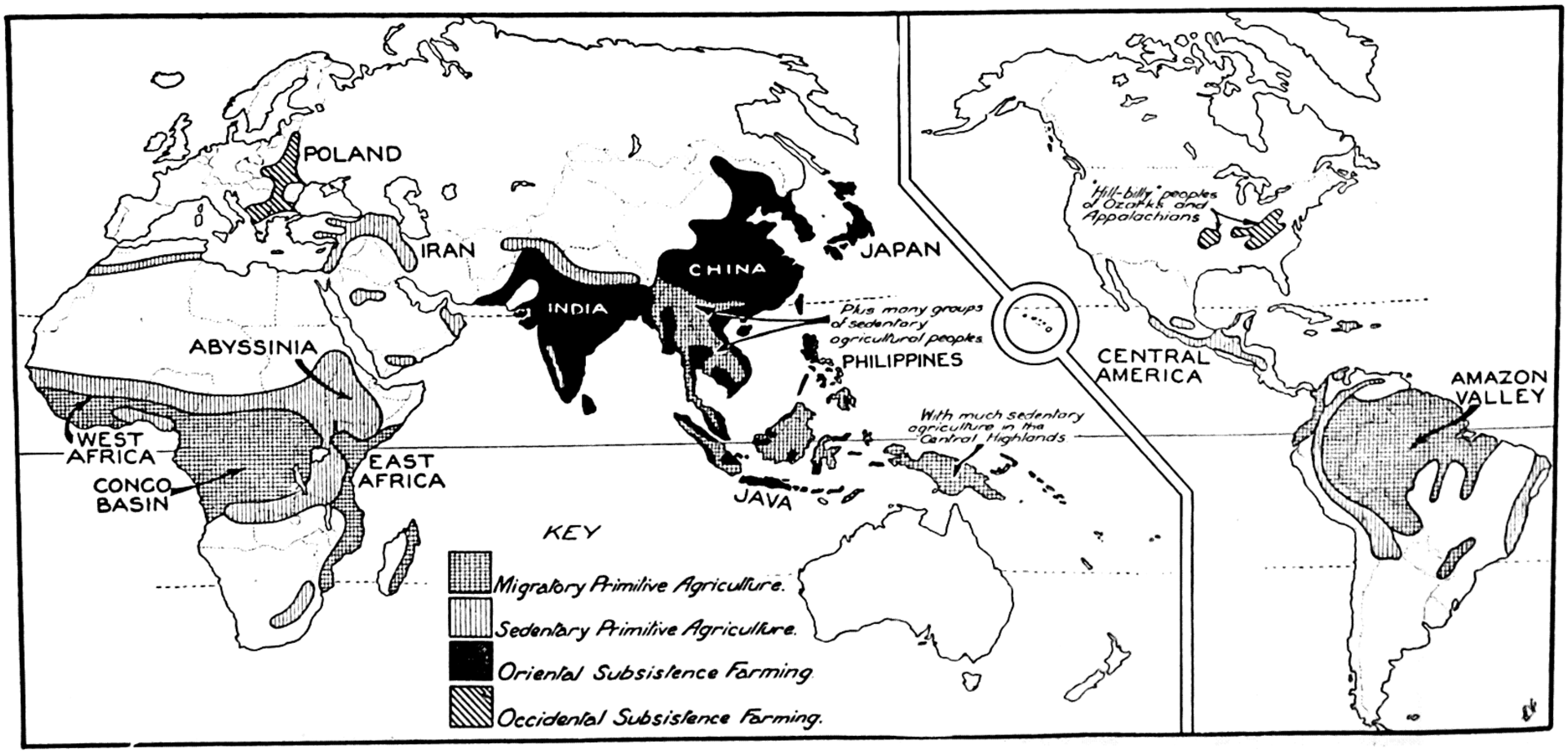

FIG. 21. Subsistence agricultural regions of the world.

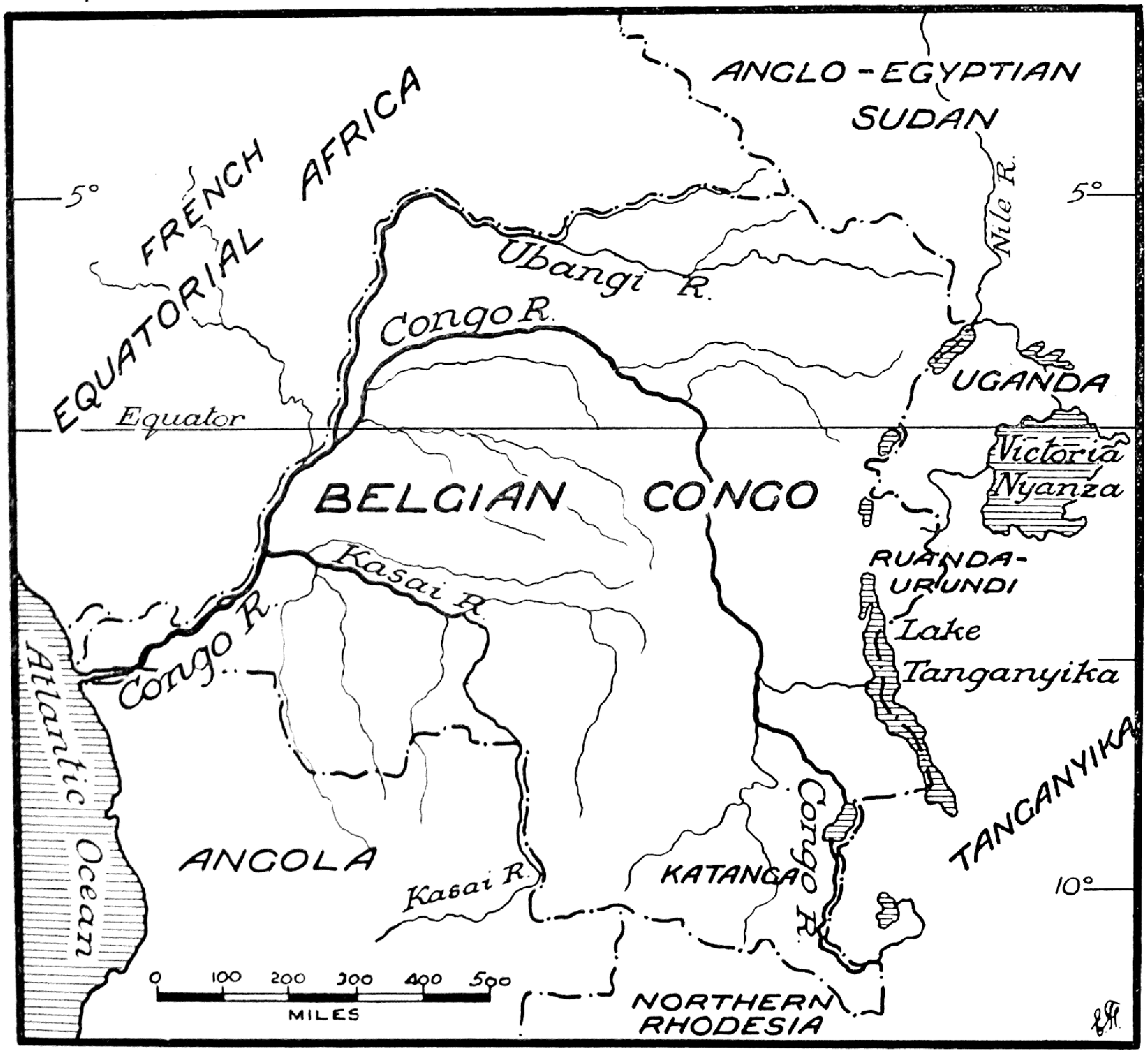

FIG. 22. Locality sketch-map of the Congo area

fast disappearing where contact with more advanced techniques has occurred.

Since the migratory and oriental forms will be dealt with fully in the following chapters it will be sufficient here to notice some features of the other two types shown on the map.

(a) **Sedentary primitive agriculture** is practised in (*i*) small areas of the hot, humid lowlands; (*ii*) the wet-dry low latitudes; and (*iii*) highland areas in both the tropics and temperate lands.

In the humid tropical lowlands the general farming practice and the nature of the products are the same as those of the migratory farmer, but here (*i*) the farmer takes more care in the preparation of his land and in the cultivation and harvesting of his crops; (*ii*) he builds a substantial home; (*iii*) he uses better tools, which are often purchased from outside traders; (*iv*) individual land ownership is frequently found instead of collective land tenure common among migratory peoples.

In the wet-dry low latitudes the sparser vegetation cover and low rainfall make it easier to keep down the growth of natural vegetation. Soils also are less lateritic, have a higher percentage of humus and are not heavily leached under the seasonal rain conditions. However, the occurrence of droughts is of some importance in limiting the types of crops grown and affecting the yield in those years when they occur. Tillage methods are more intensive than with migratory farmers, but all work is still done by hand and the hoe is the main implement used. Soils are seldom fertilized and yields are low because of this and the crude cultivation methods. Animals are kept almost everywhere, but are used rather for draught purposes than as a source of food, except where these areas form the permanent quarters of nomadic peoples (see page 18).

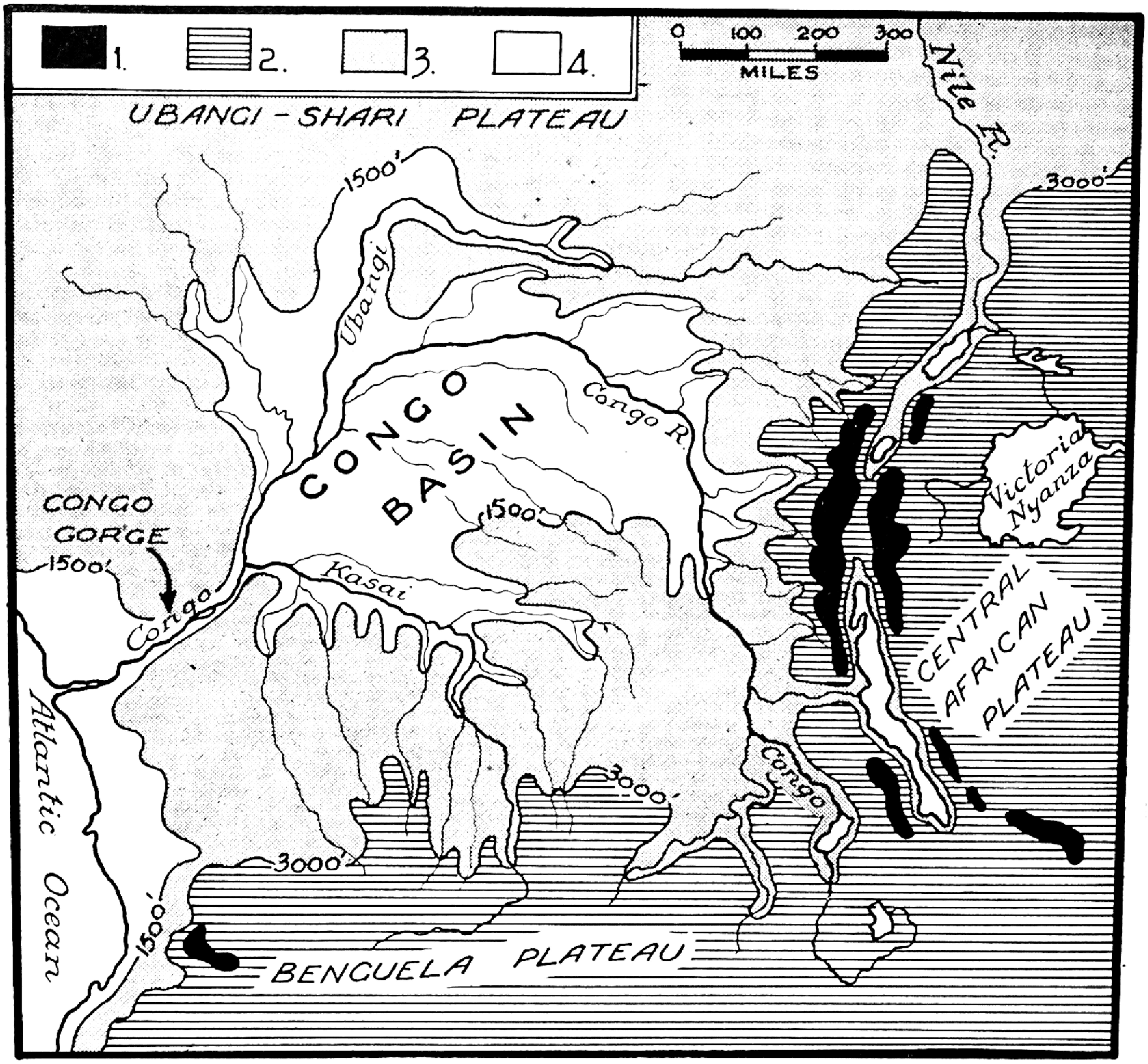

FIG. 23. Landforms of the Congo area.
1. Land over 6,000 feet. 2. Land between 3,000 feet and 6,000 feet. 3. Land between 1,500 feet and 3,000 feet. 4. Land under 1,500 feet.

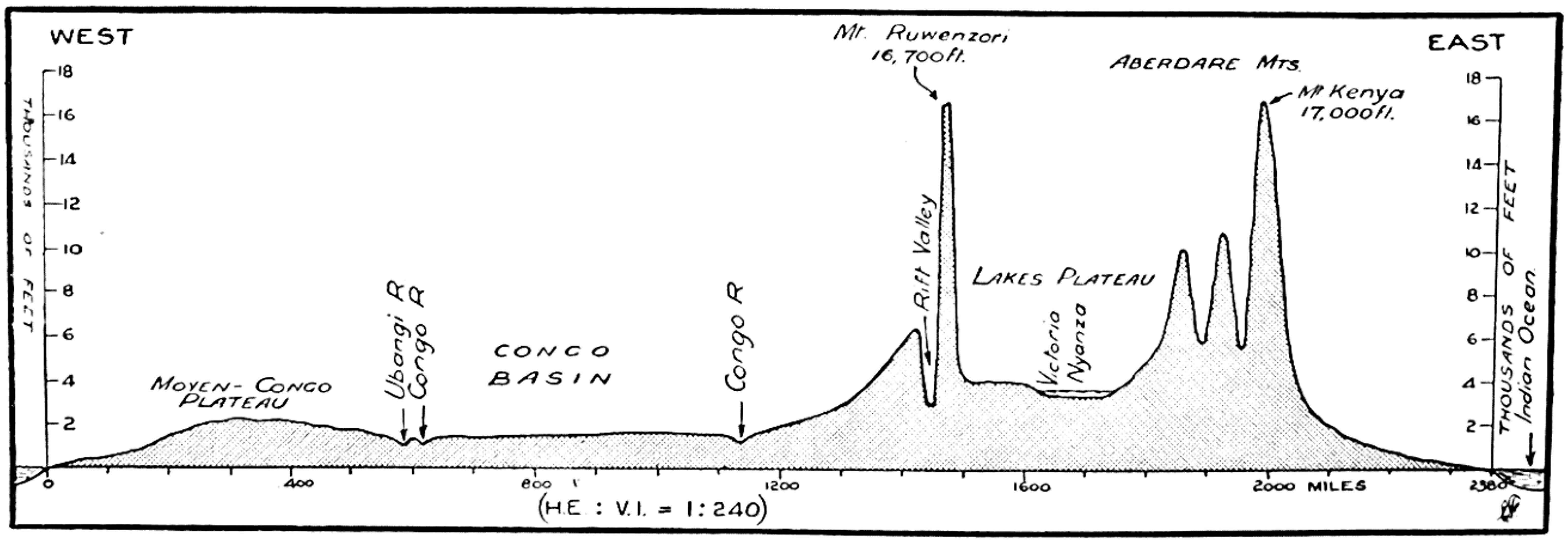

FIG. 24. Sketch section across Africa to show the relation of the Congo basin to other landform areas.

The highland areas where this type of farming occurs are found mainly in the Americas and in Asia Minor. These highlands support rather dense populations who practise hoe tillage of small plots on terraced hillsides. Irrigation is often used and is frequently very cleverly constructed. Again, animals are widely used both for food and for draught purposes.

(b) Occidental subsistence farming is found principally in Poland and south-east Europe in the Old World and in isolated hilly lands in the United States, in the New World. This type is similar to commercial crop and livestock farming, except that the farmer does not produce a surplus for sale and the farms are worked mainly by hand. The farmers are often labourers on nearby estates and live in farm villages, thus representing a relic of serfdom. Though he grazes stock and uses a system of fallow and limited crop rotation the farmer has too small an income to buy implements or breeding stock. Rye and maize are the chief grain crops and food of these people, with potatoes, turnips and barley as other staple foods. Surplus production is disposed of in nearby towns, but the prices obtained are low and the total annual income of these farmers rarely exceeds a few pounds sterling. These are poor regions with low and harsh living standards when compared with those in the commercial farming regions.

Migratory agriculture in the Congo basin. 1. Environment (Figure 22). This area lies between 5°N. and 10°S. latitude. It will therefore be essentially equatorial in most of its physical character. It is a large area, for the map depicts some two million square miles of country. The Congo basin covers about two-thirds of this area.

(a) Landforms. The Congo occupies a true geographical basin consisting of a huge central lowland, with an elevation mostly under 1,000 feet, surrounded by gradually rising ground towards the Ubangi-Shari Plateau on the north, the Central African Plateau on the east and the Benguela Plateau on the south. The only outlet from this basin is by way of the Congo gorge cut through the low Moyen-Congo Plateau on the west. Through this the great river, with a mean annual discharge of 1,800 million acre feet a year, pours to the sea. Figure 23 shows the main landform features of the basin, while Figure 24 gives the relation of the basin to the adjoining landform features.

(b) Climate. The climate of much of the Congo area is hot, humid and cloudy throughout the year. The seasonal change in temperature is very small and there is no dry season close to the equator, but two periods of rainfall maxima occur there during the equinoxes. A definite but short dry season appears north and south of latitude 5°, while south of latitude 10° the climate becomes tropical, with a dry and cooler season in the southern winter period.

The rainfall is everywhere abundant except in the south-east corner (Katanga) and the south-west coastal areas, where semi-arid conditions prevail (see Figure 25).

As the floor of the basin lifts towards the encircling rim the daily variation in temperature increases and the rainfall decreases from over 80 inches to about 50 inches per year. This has a marked influence on the vegetation types (see Figure 26).

(c) Vegetation. Figure 26 indicates that the lowland portion of the basin is covered with tropical rain-forest in which dense tree growth is the dominant type. As the encircling highlands are approached, the rain-forest gives way, first to woodland with some open patches of grassland, and then to more continuous grassland and shrubland as the upper levels of the plateau are reached. The forest of the lowlands is a true jungle, while the grasslands and woodlands of the surrounding uplands are savanna or savanna woodland.

(d) Soils. Throughout the basin proper the soils are principally laterites. These are mostly infertile and unsuited for agricultural farming because of the heavy leaching of the surface soil—A-horizon. On the uplands the soils have not suffered such heavy leaching and the possibility for agriculture is thereby increased.

2. Sociology. The Belgian Congo is mainly the bed of an ancient inland sea. When it had drained and the rain-forest had taken its place it was invaded by the first inhabitants, the hairy, dwarf-statured, yellow-skinned people whom we call the Pygmies. Tradition and folk-lore and glimpses of history tell us that they were once widespread throughout north and central Africa, but they have now been reduced to scattered groups within the confines of the equatorial forests. They are skilled only in hunting and they live in small nomad groups who build little round shelters of branches rather than huts, either on the ground or in the forks of trees. They average about four feet in height and depend for food on the game they kill with poisoned arrows or by trapping in deep pits, supplemented by fruits and berries from the forest trees and by bananas or cassava obtained by trade with the Bantus.

After the Pygmies came the Negro invaders, black-skinned, curly-haired peoples. Several groups of these settled in the Congo area and are known to-day as the Bantu. This is a linguistic division rather than a racial one, for there is little basic difference between the Negro and the Bantu. The name Bantu actually means "the men", and hence the men who speak the Bantu dialect, so that the Bantu are a collection of kindred peoples rather than a race. Physically they vary a good deal. Although they resemble the Negroes at first glance, they have less prominent jaws, sharper

noses, thinner lips and a generally lighter skin colour than the true Negroes of the West African region. They are intelligent, clannish, conservative and inclined to work by fits and starts. They are steeped in superstition and until recently have had little contact with the outside world.

The Bantu families are grouped into clans. The clans are combined into tribes which are generally small, though a few large and powerful tribes occur in the south-east. The area is therefore one of small scattered village settlements.

For purposes of discussion they may be grouped into (*a*) the tribes of the coast; (*b*) the tribes of the Congo basin and (*c*) the tribes of the uplands.

(a) **The tribes of the coast.** These people have been in contact with Europeans and their trading methods for centuries. They have acquired a taste for European goods, wear more clothing, and indulge in more ornament than the more distant Bantu. Some trade as middlemen with the inland tribes. Others work in factories or shops or, like the Krooboys, as deckhands on coastal steamers and trading vessels.

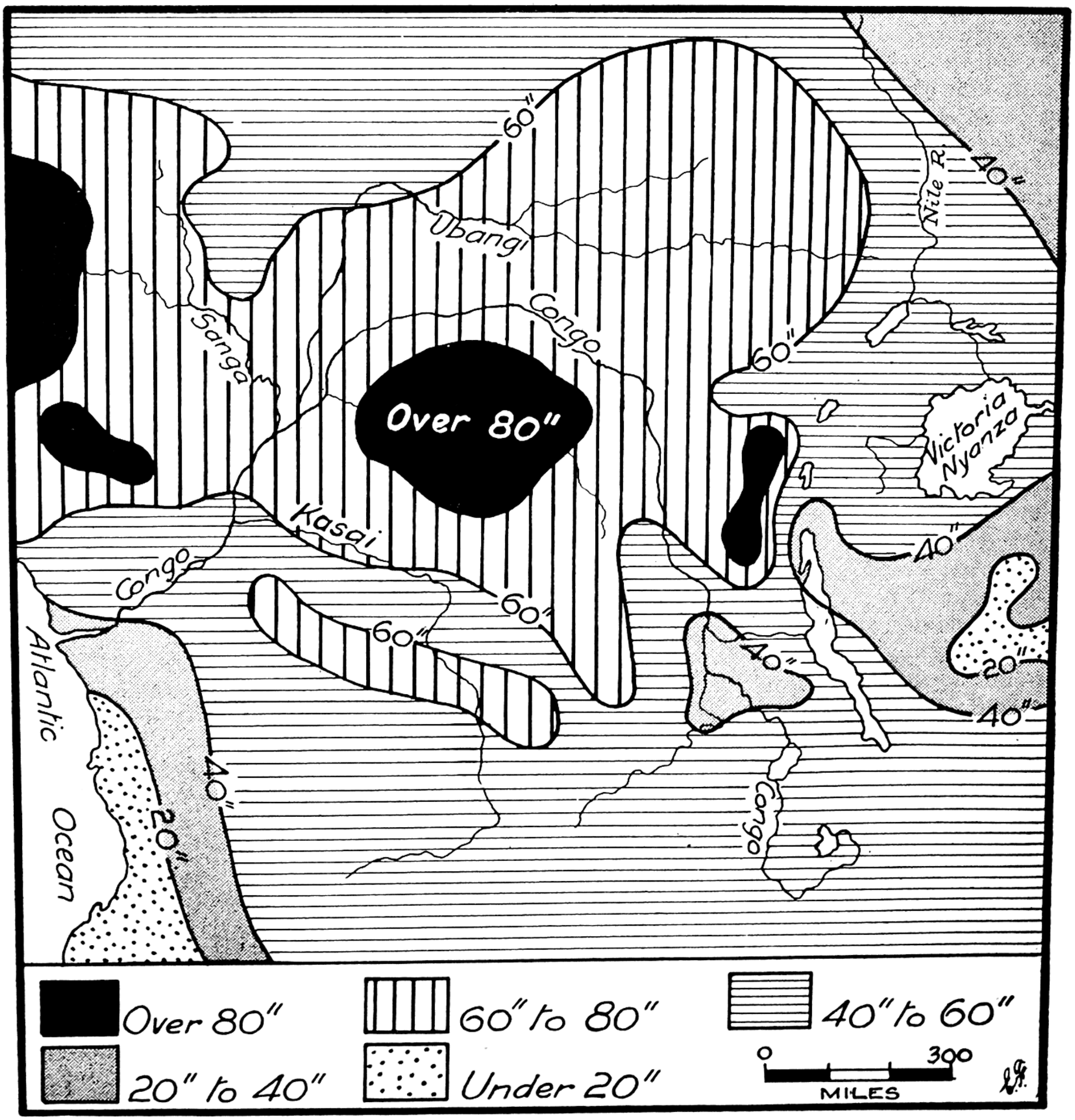

FIG. 25. Average annual rainfall of the Congo basin.

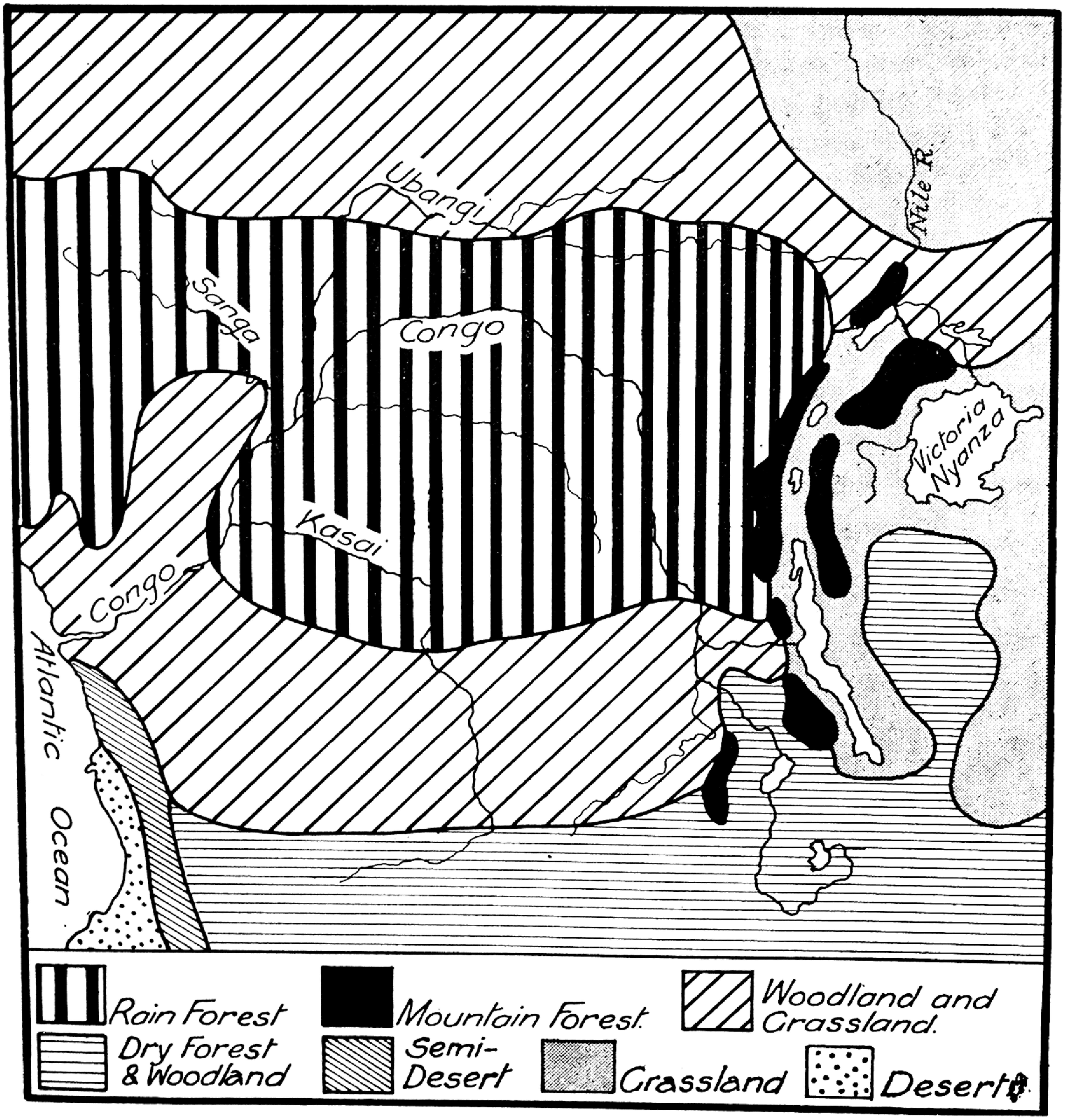

FIG. 26. Generalized vegetation pattern of the Congo basin.

(b) **The tribes of the basin.** Life in the forest is hard and sombre. The whole area is intersected by rivers and streams and it is upon their banks that most of the population lives. In the clearings along the banks people escape from the tsetse fly. The streams are used for fishing. They are also the only avenues of trade and travel in this vast forest labyrinth. Almost every tribe takes to the water if and when it can.

Within the forest agriculture is a constant routine of clearing the site (usually but a few acres), burning the felled timber and undergrowth, hoeing, and planting in the ground enriched temporarily by the potash obtained from the burning. The clearing and burning are the men's work, the hoeing, planting and harvesting the women's. Often the larger trees are left standing, for the small native axes and the scant energy of these peoples are unsuited to heavy tasks.

This is manioc country, since manioc is the most dependable crop. Sweet potatoes, yams and bananas are also grown, whilst near European influence tomatoes and maize may be found. In this virgin soil, with its potash enrichment, the plot may serve up to four years before it is exhausted by leaching and general soil impoverishment from cropping. No manure is added, for the use of animal manure is strange to the African, and in any case no cattle may be kept in the tsetse fly country. After a time, dwindling crops make a move necessary and the whole process is repeated in a new spot. These people, however, are not truly nomadic, for their dwellings are semi-permanent and they may live in the one village for several decades while using the available farmland surrounding it. In addition to the crops from the farm plots the forest also supplies game, fruits, roots and a few products such as rubber and palm oil which may be bartered for salt, tools and household articles in trading centres throughout the area.

Wherever possible, tribes use the fish of the streams as a supplementry diet and the fish traps used show remarkable skill and ingenuity in their construction. The fish are eaten fresh or smoked for trade in the towns.

(c) **The tribes of the uplands.** In these areas the more open country offers some chance of cattle farm-

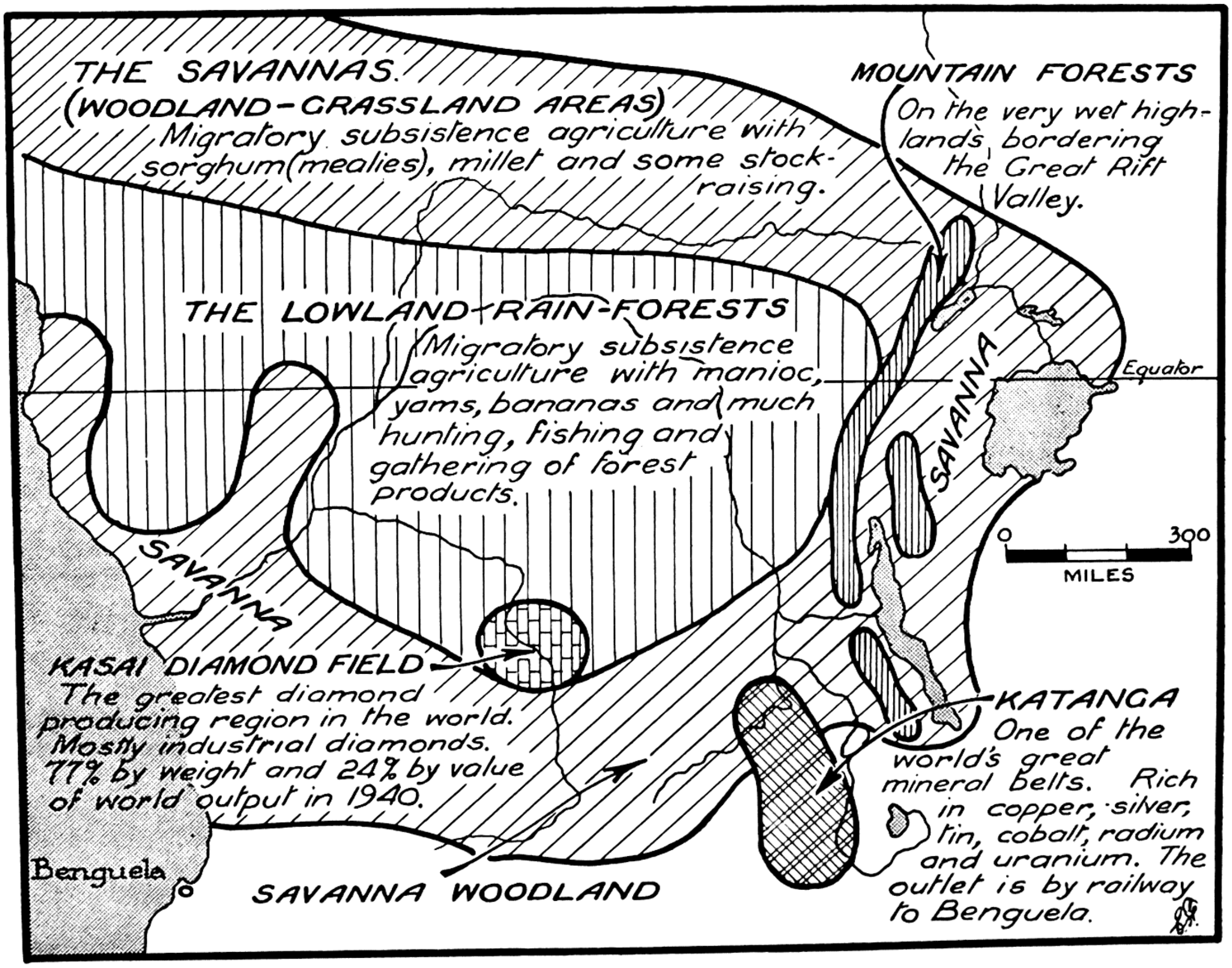

FIG. 27. Map summary of land occupancy of the Congo area.

ing, but this open country is interspersed with bush which shelters the tsetse fly. The Bantus here are generally slimmer and taller than those of the forest.

In the Katanga region agriculture begins to assume a new form in order to supply the mining population, and ceases to be purely for subsistence. In the mining towns (see Figure 27) a new, mixed population has grown up in European rather than African fashion.

In the Ruanda-Urundi districts the agriculture follows the same general pattern as in the forests, but is devoted to grains rather than cassava. There is less clearing to be done in these open woodland savannas but the same routine of shifting agriculture is practised. Cattle are abundant in these areas, but the cattle owners are the Hamitic tribes, while the Bantus are in the main agriculturists who are not allowed by their Hamitic overlords to own cattle. The cattle are mainly used as a sign of wealth and any idea of milking them or using them generally for draught purposes is foreign to these peoples.

Among both the upland and lowland tribes markets are held at regular intervals, usually about once a week. Natives come to these markets from near and far, bringing their surplus produce for barter and exchange. The market lasts a day and only the refuse is left to mark the scene.

The houses are of two types, corresponding roughly with the limits of the forest and the upland. In the forest they are rectangular; on the upland they are circular. In both cases they are built of sticks with thatched roofs and walls.

The tools used are simple. The plough is almost unknown and most of the clearing and farming is done with an axe, a slashing knife, and a hoe. Sometimes a primitive rake and a planting stick are used as well. The hoe is the principal agricultural tool and is particularly well adapted for use in the irregular and awkwardly shaped plots.

5

ORIENTAL SUBSISTENCE AGRICULTURE

1. Landforms. In the discussion relating to Figure 8 it was pointed out that the heart of Asia consisted of a series of great basin plateaux with high bordering mountain ranges, such as the Khingan, Nan Shan, Szechwan Alps and the Yunnan Highlands on the east and the Himalayas and Sulaiman Mountains on the south. Spurs, foothills and fractured plateau-blocks extend east and south-east from these bordering mountains to create a very diverse pattern of landforms in their marginal lands.

Many large streams drain south, south-east and east from the plateau heart land and its towering mountain borders. These and their tributaries have been the principal agents creating the pattern of dissection found in the marginal lands. They have been responsible also for the building of extensive flood plains and lowland areas, which have become so significant as foci of settlement.

Figure 28 shows the general pattern of lowlands and plains throughout south-east Asia and it should be

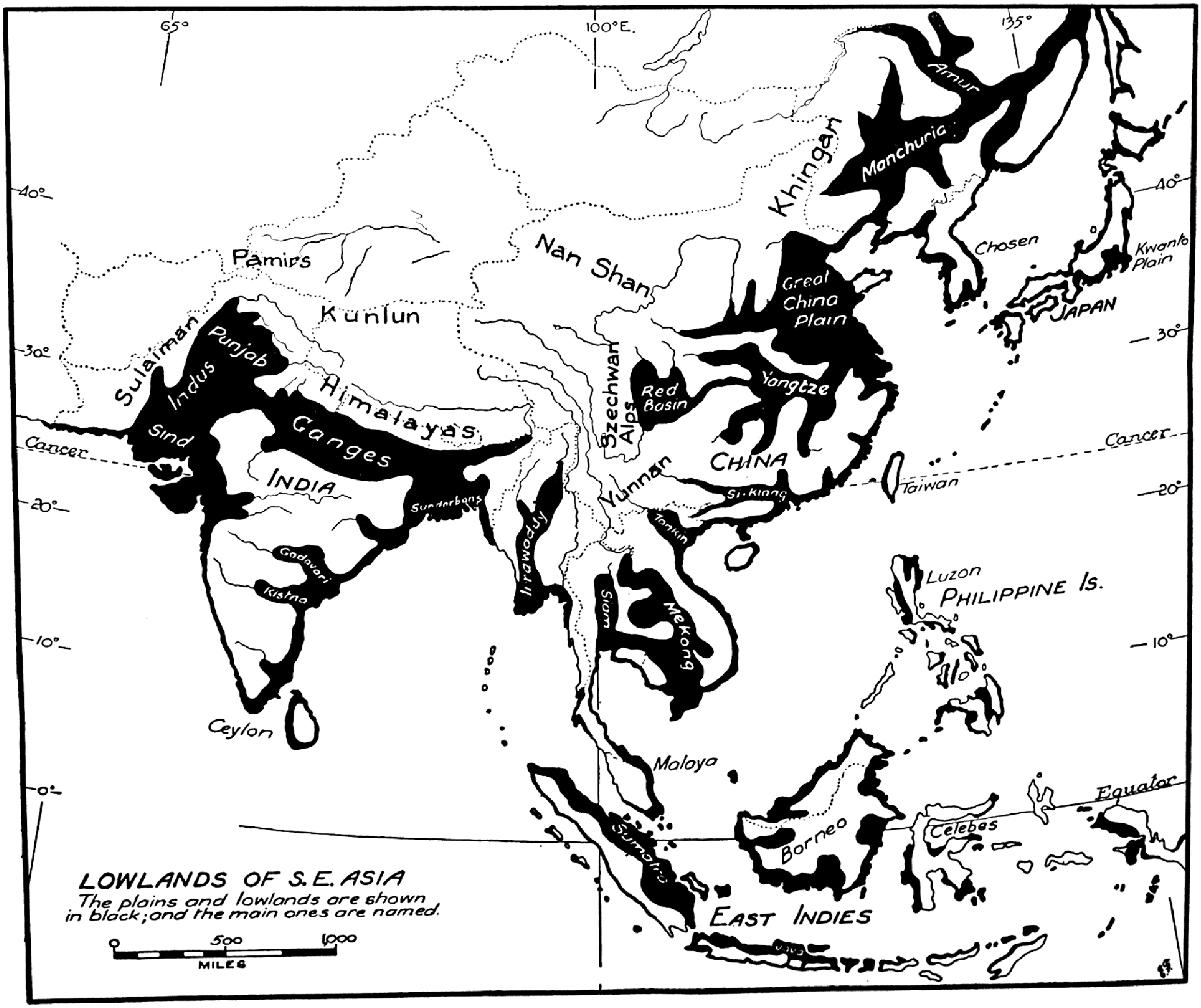

Fig. 28. Lowlands of south-east Asia.

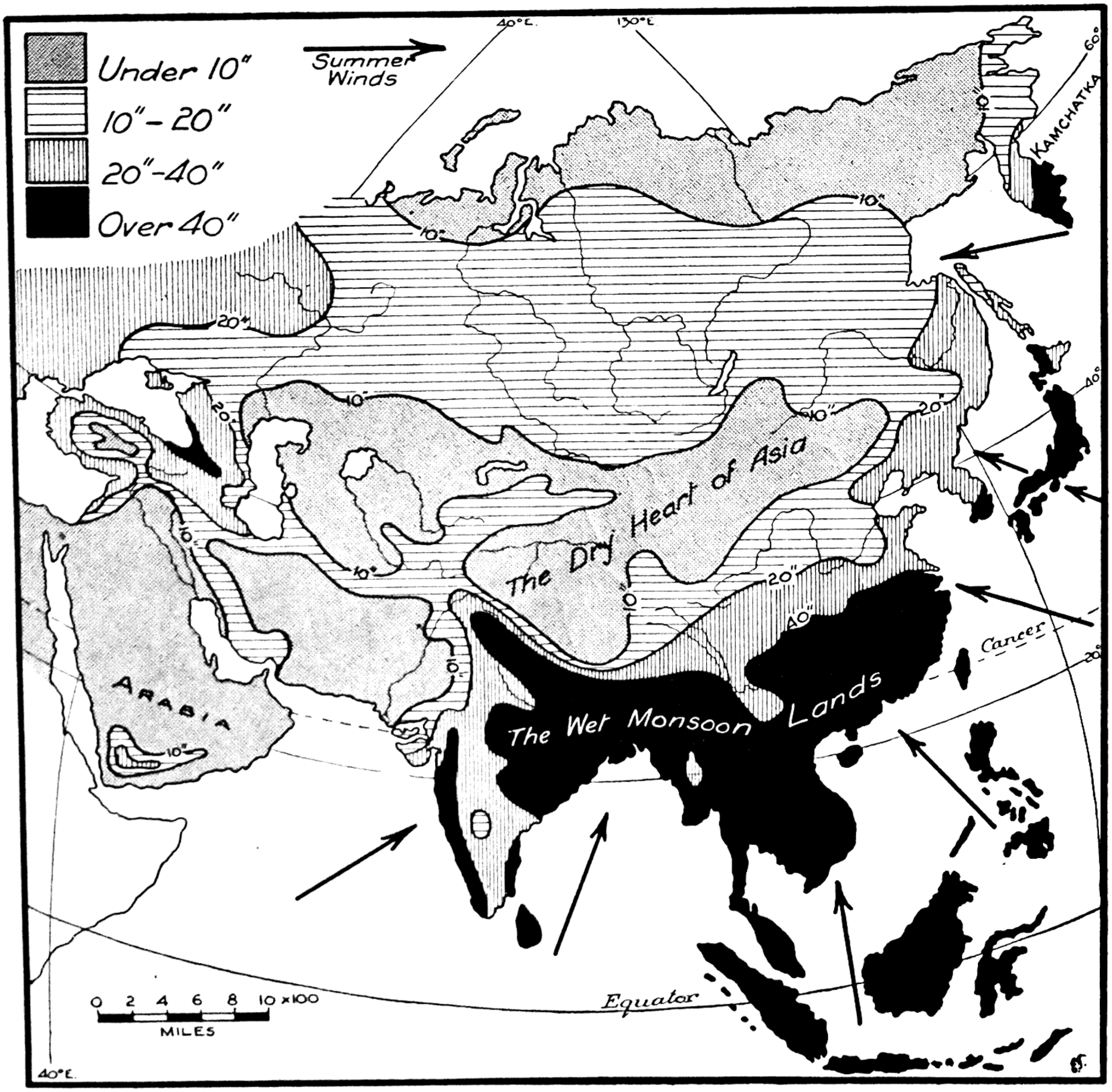

FIG. 29. Annual rainfall of south-east Asia.

carefully correlated with Figures 30, 32 and 33 in order to understand fully the great significance of these lowlands to the farming inhabitants of this region. Several of these riverine lowlands have assumed great importance because of specially favourable soil and climatic conditions. The Great Plain of China, and Red Basin, and the Yang-tze lowlands are the main areas of population concentration in China. The Irrawaddy acts similarly for Burma. The Indo-Gangetic Plain is India's main area of development. The plains of Manchuria and the Amur River have been opened up only recently by agricultural peoples and are not as yet fully developed. Among the island groups, the Kwanto Plain of Japan, the Luzon lowlands and the plains of Java and Bali show almost unbelievably dense concentrations of farming peoples, often over 2000 to the square mile of occupied land.

The centuries-old pressure of population on these fertile flat farming lands has forced the farmers "to climb the hills" of the adjoining valley sides, with the result that terracing of these lower slopes is an almost universal feature of the south-east Asian landscape. It is particularly well developed in the Red Basin (China), Honshu (Japan), Java and the Philippines, where population density is very high and the flat land areas very limited.

2. Climate. This is monsoon Asia, for here these seasonable winds reach their highest development, their greatest intensity and their widest areal extent. Though the great focus of monsoon activity occurs in

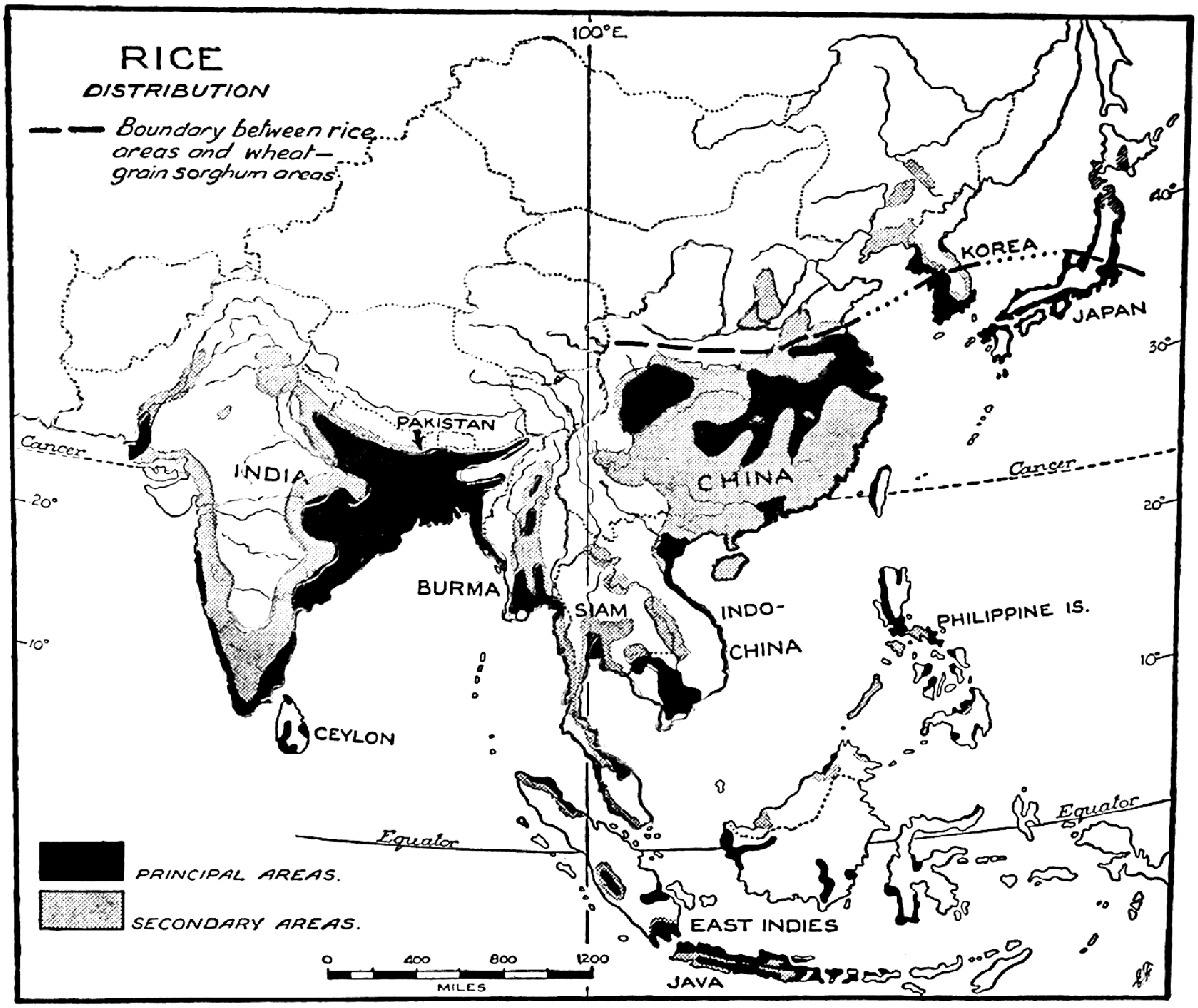

FIG. 30. Distribution of rice-growing in south-east Asia.

India, Burma, Indo-China and the Philippines their influence is felt on all the marginal lands of the continent from Arabia to Kamchatka. A study of the monthly rainfall graphs for China and Japan will emphasize this point.

Figure 29 shows the pattern of rainfall distribution and the amounts of rainfall throughout south-east Asia. The general concentric pattern from the dry heart land outwards towards the east and south-east is at once apparent.

During the summer months this huge land mass becomes sufficiently heated to create an area of low barometric pressure of greater intensity than that over the tropical seas to the south of the continent. The centre of this land-situated low pressure is over northern India. As a result of this there is a great in-pouring of winds towards the heated areas during the period from June to October each year. The general direction of these winds is indicated by arrows on Figure 29. Blowing from the sea, they are heavily laden with moisture and bring rains to the marginal lands of the continent. The amount of this rain is increased by the mountain barriers to the interior basin plateaux; but the highest totals occur in the south and south-east, where the warmer winds from tropical seas carry more moisture than do those in the Japanese or eastern Siberian regions.

In the winter period (from November to April), the land mass cools to very low average temperatures, resulting in the development of a strong high-pressure centre in eastern Siberia. From this centre there is a general out-pouring of cold, dry winds in almost the opposite direction to that of the summer winds. These off-shore winds are normally dry, but they bring rain to places where they cross water bodies before reaching land areas; e.g. in western Japan, the Philippines, the East Indies, Malaya and Ceylon. In addition, cyclonic storms cause a moderate winter rainfall and much cloud and fog in the Yangtze valley.

The great significance of this seasonal régime of rain and dry conditions lies in the fact that the yearly routine of half the world's population is dependent

on it, and that any serious variation in its intensity or time of arrival creates famine or near-famine conditions among these teeming millions.

3. Farming. The discussion here will be along fairly general lines, since the following chapters on China and Japan give greater details for each of those countries.

In Figure 30 the rice-growing areas are mapped. The general correlation between these and the high-rainfall lowland areas shown in Figures 28 and 29 should be noted. In addition, the position of the boundary between rice and other small grains should be observed. Actually, this line represents the northern limit of rice as an important crop rather than a clear divide between the two types, for Figures 32 and 33 will show that many of the small grains and legumes are grown south of this boundary. This line corresponds approximately with the 32°F. winter isotherm and it is to be regarded as one of the major crop boundaries in the Western Pacific lands. North of the line the growing season is limited to eight months or less and the principal crops are kaoliang, millet, wheat, barley and soy beans. South of the line the growing season gradually increases from eight to twelve months at the tropic; and one-crop and two-crop rice cultivation appears, together with many associated and rotational crops, among which vegetables (particularly sweet potatoes, legumes and greens), maize, barley, peanuts, cotton, sugar-cane, and orchard fruits are important.

Oriental agriculture is characterized by small farms, usually broken into non-contiguous plots scattered round a village where the farmers have their dwellings. On uneven land the plots are terraced up the lower hillslopes. It is a garden type of agriculture in which the crops are grown by intensive hand-cultivation methods for direct human consumption. The hoe is everywhere outstanding among the few implements used by Asian farmers. Only about one-third of the farmers use draught animals and ploughs and the high yields are the result of painstaking human labour rather than of machine cultivation. **Rice** is the dominant crop over most of the region and it is associated with various dry-season crops. In growing it, crop rotation, developed as the result of centuries of experience, is a regular practice, together with much inter-culture (i.e. the growing of two or more crops at the same time in alternate rows on the one plot of ground). Because of the absence of pasture lands, animals other than the omnivorous swine, fowl and goat are relatively unimportant in the farming economy; but fish, both from ponds and open waters, are a vital part of the food supply in these regions. The continuous cropping has been made possible by constant heavy manuring of the soil, in which all refuse matter from the homes, animal droppings, and nightsoil are used. Since the major effort is directed towards the production of foodstuffs for personal use there is little surplus of these products for sale to outside areas. Owing to the common practice of utilizing embankments round rice fields and small plots near the villages as well as the hillsides which are too steep for rice, for growing commercial crops, there is quite often a regional surplus of these for sale on the world markets. Thus we find cotton, rubber, sugar, soybeans, tobacco, tea, silk, coconuts and kapok all being produced and sold in large regional quantities by native cultivators, as well as by the plantations within the area. It is from the sale of such products, plus the payment for occasional labour on plantations or large estates that the native farmer obtains small sums of money with which he purchases such tools and meagre household necessaries as he may require.

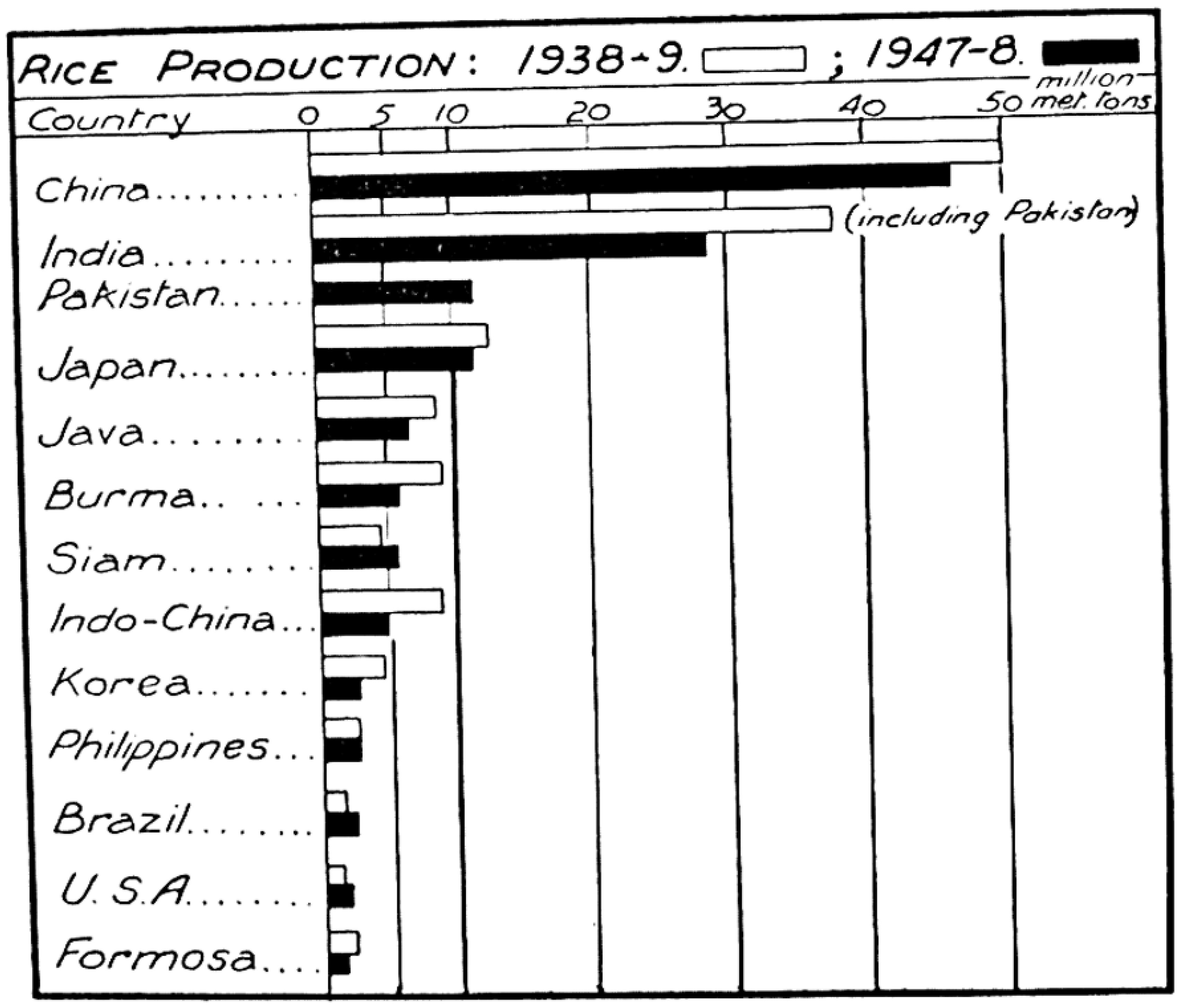

FIG. 31. World rice production.

This intensive form of land use results in very high population densities with a general over-all pattern of villages grouped at close intervals in much the same manner as individual farmhouses might be spaced over reasonably fertile farming lands in Australia or North America. When examined over small areas, the pattern of settlement reflects the detailed topographic pattern very closely, since the farmers avoid rugged ground and cling to valley floors and lower foothills (see Figure 40).

Increasing populations within the south-eastern Asian area, following better controls over disease and infant mortality, have created grave problems of food supply. Little or no further virgin land is available for cultivation. Up to the present the food demands of the greater populations have been met by slightly increased yields from some of the farming areas, together with a general lowering of the calorific intake for the majority of the inhabitants until, in most Asian

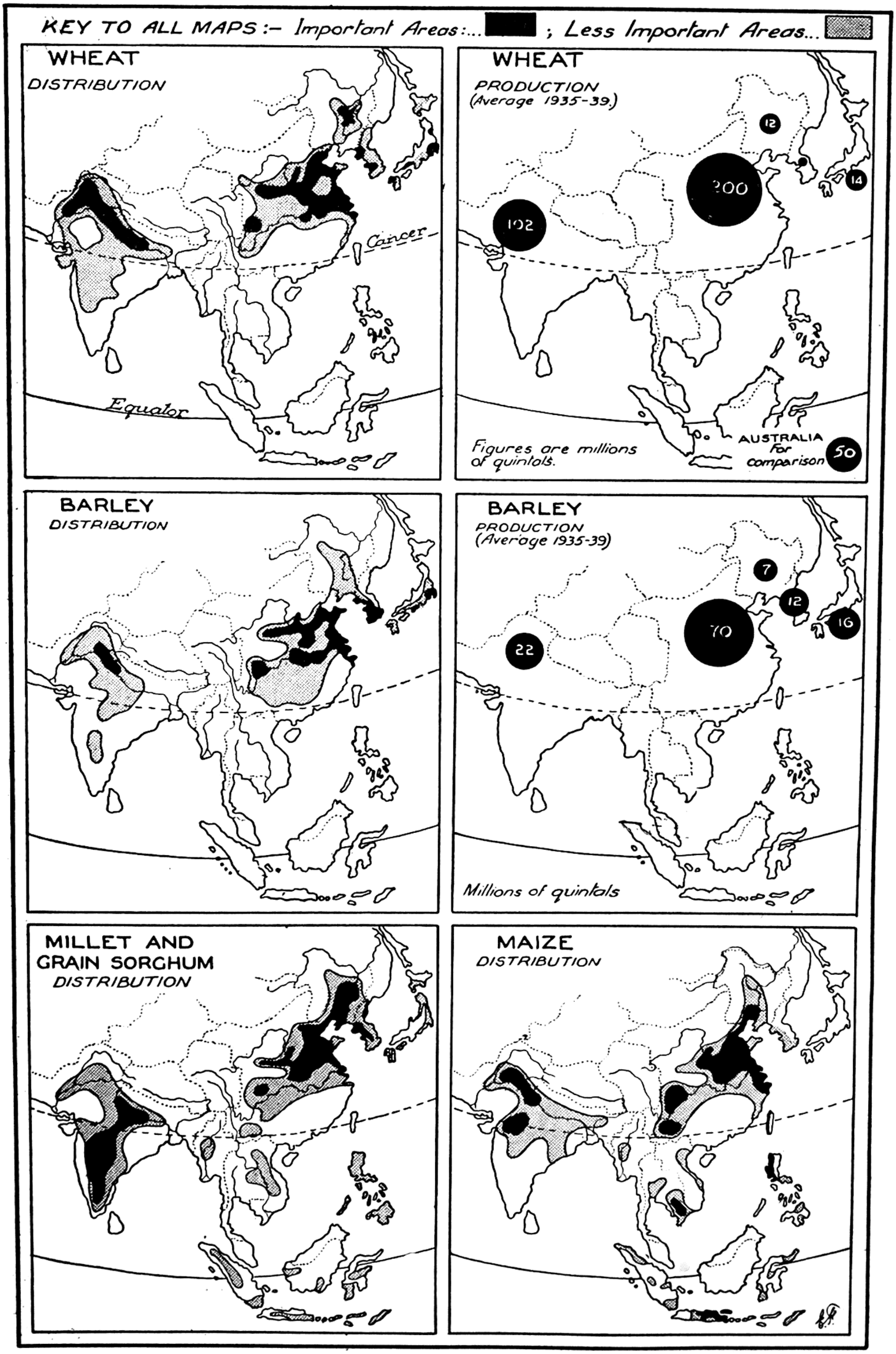

FIG. 32. Distribution and production of some crops associated with rice-growing in south-east Asia.

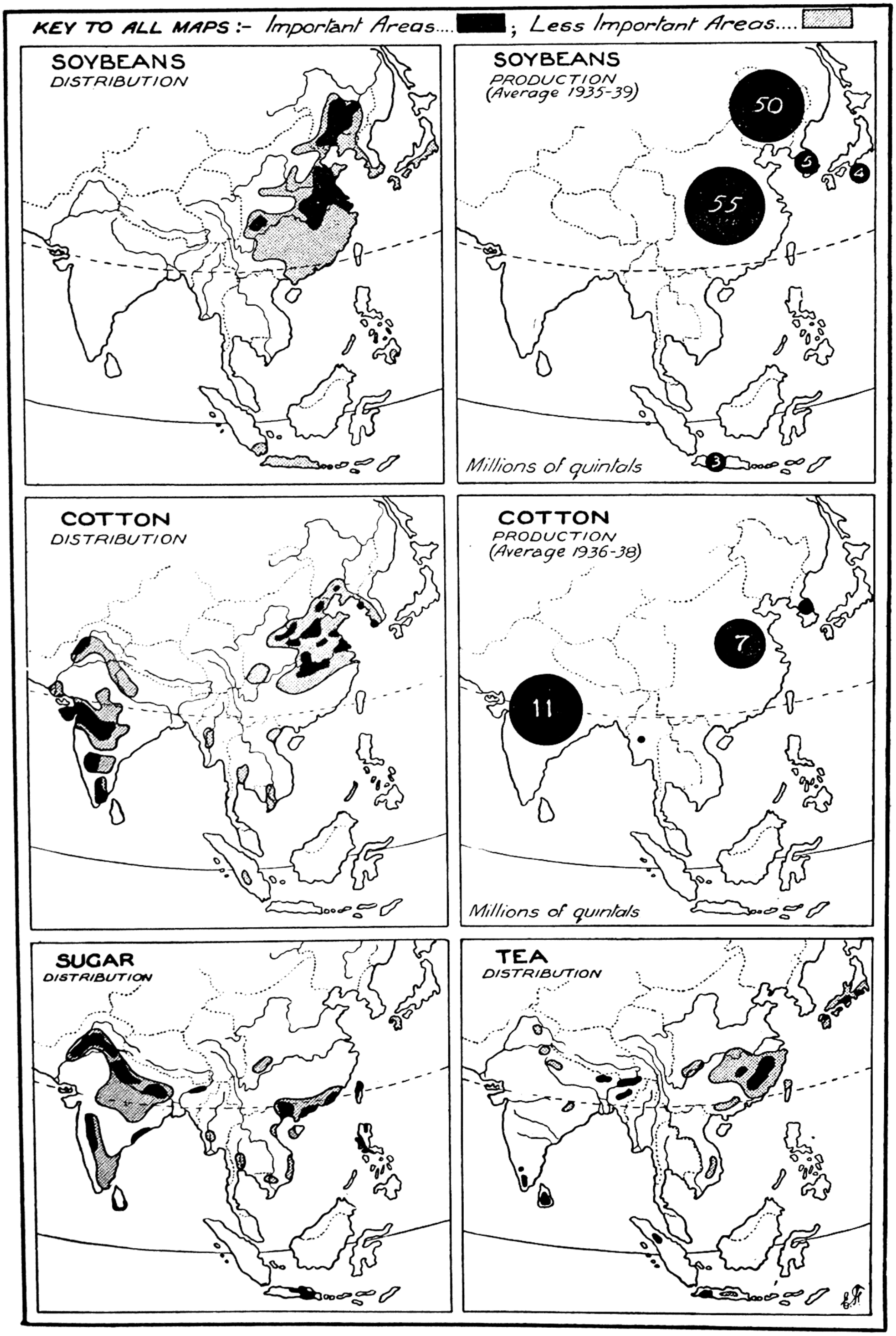

FIG. 33. Distribution and production of some crops associated with rice-growing in south-east Asia.

countries, it is but little above the basic sustenance level.

The map of trade (Figure 34) emphasizes the subsistence nature of livelihood throughout this area. The only countries where trade approaches that of a commercial farming country like Australia are Malaya and Ceylon, where plantation agriculture is of great importance. Similarly, but in a smaller way, the trade of Formosa and the Philippines is affected by plantation agriculture.

SUBSISTENCE TILLAGE IN CHINA

Landforms. 1. China is almost as complex as Europe in its general structure and landforms, but it differs greatly from Europe in its relation to the sea. In place of a great peninsular projection as in Europe, China presents a huge convex salient to the seas separating it from the island festoons which front the true Pacific. Nowhere, except in the Gulf of Pohai, does the sea penetrate deeply into the interior.

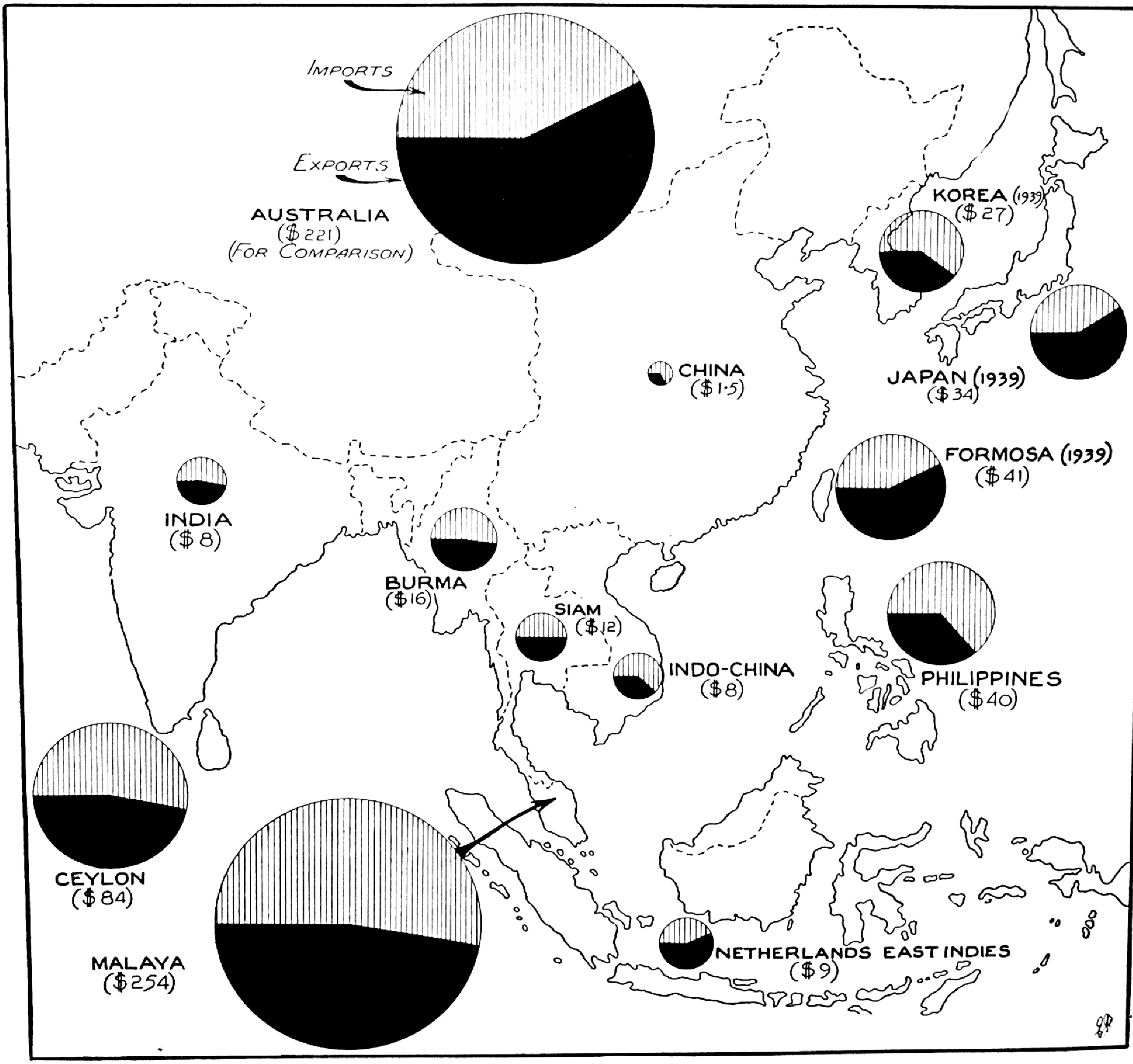

FIG. 34. Trade per head of population in south-east Asia.
The total trade is stated in U.S. dollars for the year 1947 (except for Japan, Korea, and Formosa, where figures are for 1939). The areas of the circles are proportional to the total trade per head, exports being shown in black and imports in shading.

Hence, China is essentially continental in character, with great mountains and deserts on its inner side and, until recently, an oceanic barrier on its eastern side. Between them these two barriers caused the pronounced isolation that accounts for so many of the distinctive features of the historic civilization of the country.

2. Figure 35 shows that China has an extremely diversified surface relief. Though there are considerable areas of lowland (e.g. the Great Plain is larger than Victoria) most of the surface is hilly or mountainous or severely dissected plateau. The concentration of agriculture and population into basins and plains as a result of this relief pattern is one of the outstanding features of the human geography.

3. On the west it is backed and delimited by the lofty Tibetan plateau, with the flanking Szechwanese Alps along the Chinese borderland rising to over 23,000 feet. To the north of Szechwan these alpine mountains extend eastward as the Tsin-ling Shan, constituting one of the major geographical divides of the country.

4. North of the Tsin-ling Shan the Mongolian Plateau is flanked by a series of sharp ridges formed

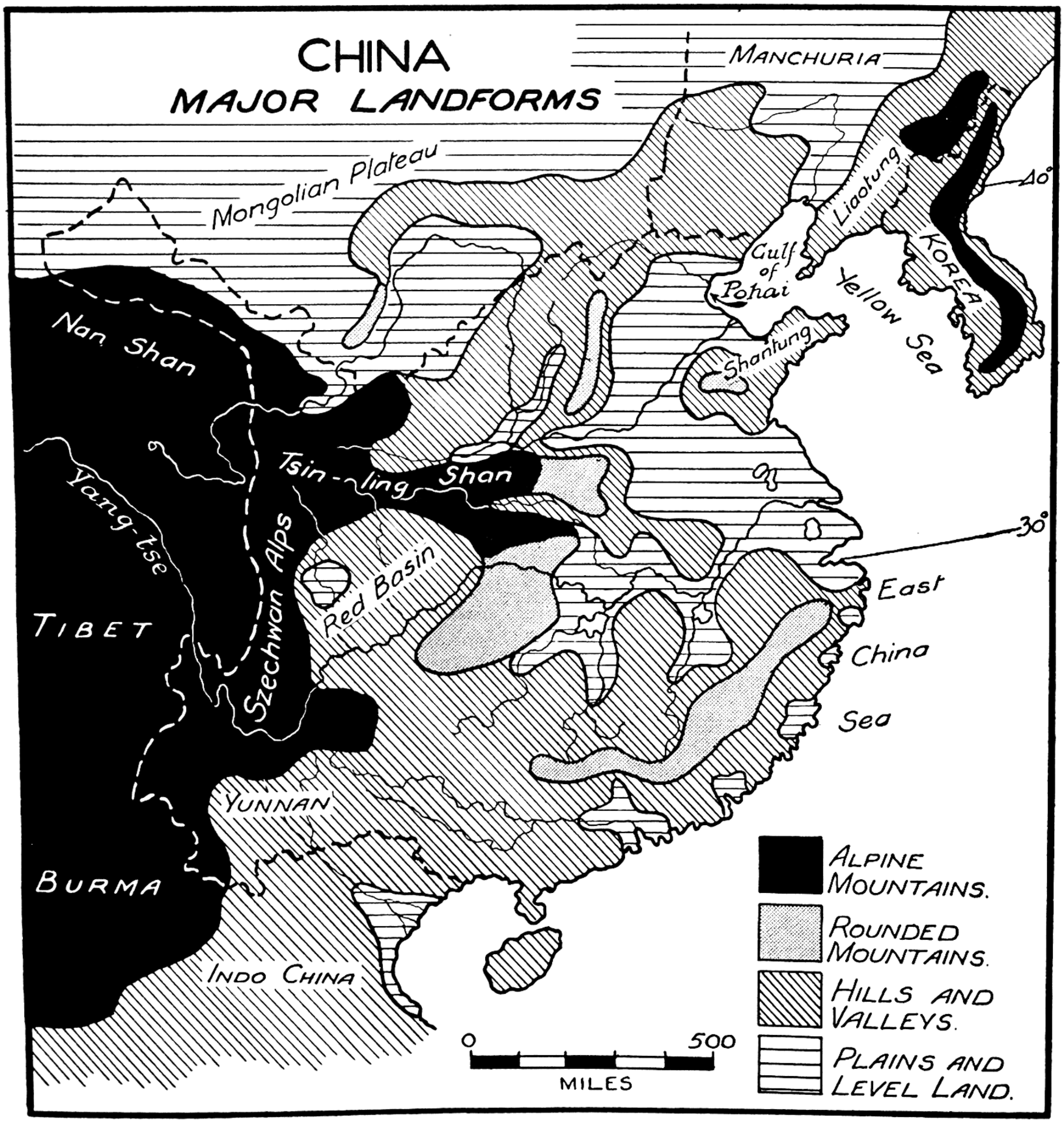

FIG. 35. Major landforms of China.

as the result of fracturing and tilting of the plateau edge into a series of block mountains (the Khingan) with steep eastern scarps.

5. China descends eastwards from the high interior of Asia by a series of terraces and steps in which the three great valley-basins of the Hwang-ho, Yangtze-kiang and Si-kiang form the main foci of settlement.

6. The rounded mountain regions of the south-east and the Shantung Peninsula are the remnants of a very old land mass wherein fracturing, faulting and long dissection by streams have produced high, rounded tops and a pattern of jumbled hill ranges of moderate elevation.

7. The hill and valley area of the south is of varying structure. Much of it has resulted from the erosion of the ancient land mass; but in Yunnan it has been formed by dissection of the series of step plateaux by which the alpine hinterland descends to the Chinese foreland. Here the streams run in deep canyons traversing areas of rolling upland between 4,000 and 6,000 feet in elevation. Old lake-filled basins on the plateau surface are the principal areas of settlement, as the valleys are difficult of access and are mostly covered with malarial-stricken jungles. Vast areas of grassland on the plateau and the lower mountain slopes offer possibilities for the development of grazing far beyond their present use.

8. The plains and level lands fringe the country on the east. They reach their greatest extent in the lower Hwang-ho and Yangtze valleys, where they form the flood-plains of these streams. The map shows that the plains of the south-east are merely valley pockets in the highland area, comparable with the valley plains on the coastal streams of New South Wales or Queensland.

The Great Plain of China and the lower Yangtze plain are composed of alluviums of great depth. Soils in them vary considerably, but are generally of high fertility, though their level nature creates drainage and flooding problems.

9. The Red Basin of Szechwan is one of the most clearly defined natural regions in the world, being surrounded by high mountains with only two outlets, one by way of the Yangtze gorges in the east, the other by the Kialing valley on the north. It is composed of rolling and hilly country with a general tilt from north to south. Here a combination of mild moist climate, rich purple-red soils, and the industry of the farmer inhabitants has resulted in the development of one of the most intensively farmed and densely populated areas in China. The extensively terraced hillsides; the flooded rice fields of the valley floors; the widely spread plots of maize, sugar-cane, tobacco, vegetables, sweet potatoes, oranges, tea and cotton; bordered by mulberries and backed by forested slopes, give a picture of such attractive orderliness and prosperity that Szechwan has long been known as "The Eden of China".

Climate. 1. China is situated on the eastern fringe of the largest continental land mass in the world, a fact which causes its climate to be affected by continental influences rather than by the nearby Pacific.

2. The underlying feature of all Chinese climates is the monsoonal régime, the general details of which were discussed with Figure 29. In China, the winter monsoon with its cold dry winds is more marked and persistent than in India. During autumn it spreads its influence from north to south over the whole country, being interrupted only by a series of winter cyclonic storms which originate in the Tibetan area and move eastwards along the Yangtze valley to cross the China Sea to Japan. These storms are responsible for the autumn and winter rains so characteristic of the Yangtze valley area (see Figure 36).

3. **Temperature.** (*a*) The greater part of the North China Plain, Mongolia and Manchuria have from one to three months of average temperatures below freezing point in the winter, and frosts are usual between late October and April.

(*b*) The freezing of the seas, rivers and harbours of this area for at least one month in mid-winter greatly affects their value as waterways and ports.

(*c*) South of the Tsin-ling Shan there is a well-marked cool season, but though snow falls over much of the area, temperatures average above 32°F. In the sheltered Red Basin of Szechwan the winter monthly averages of 45° to 49°F. compare with those of Melbourne or Hobart.

(*d*) The summer temperatures are high in all parts of China except the western mountains. Most of the country now averages above 80°F., while the south-east coasts average 85°F. Coupled with the high humidity in the southern areas and the rainy season of the summer months these readings make the climate there comparable with that of Cairns or Mackay in Queensland. Such conditions also favour the maximum of plant growth in all areas.

4. **Rainfall.** Figure 29 gave the general pattern of rainfall throughout China and Figure 36 shows the pattern of monthly distribution.

(*a*) Study of both maps will show that the Tsin-ling Shan forms a major rainfall divide as well as a temperature divide. North of the range the rainfalls are low and the winters dry (see Taiyuan, Peking and Luan graphs), while south of it the annual totals are much higher and there is some winter rain (from the cyclonic storms mentioned above).

(*b*) The graphs over the whole map show clearly the influence of the summer monsoon winds on the rainfall, for everywhere there is a marked summer maximum of rain.

(*c*) Note also the general contrasts between the east and west as well as between north and south (e.g. Shanghai and Chengtu graphs).

(*d*) The total rainfalls of the south and south-east are high enough to give those areas a very wet climate, comparable with the coastal areas of Queensland or northern New South Wales.

Chinese agriculture. China is a land of farmers with a great agricultural civilization; all her social and economic problems are related to the farm and the soil. Approximately 75 per cent of the population is directly engaged in agricultural pursuits and the proportion of those dependent on the land for their livelihood is higher still, probably 90 per cent.

Many factors influence the farming pattern and farming activities. The general background of physical features, climate and soils shows that in spite of a relatively good physical basis wide tracts of China are unfit for cultivation. The proportion actually utilized has been estimated at only 27 per cent of the total area of China proper. For comparison, Japan uses 17 per cent, India 46 per cent, Great Britain 23 per cent and the United States 23 per cent. An outstanding feature of the agricultural pattern is the concentration in the alluvial plains and river basins to the exclusion of all but the lower slopes of the hilly regions. Figure 37 illustrates this point very clearly, as well as showing the great importance of the Great Plain, the Red Basin and the Yangtze delta areas.

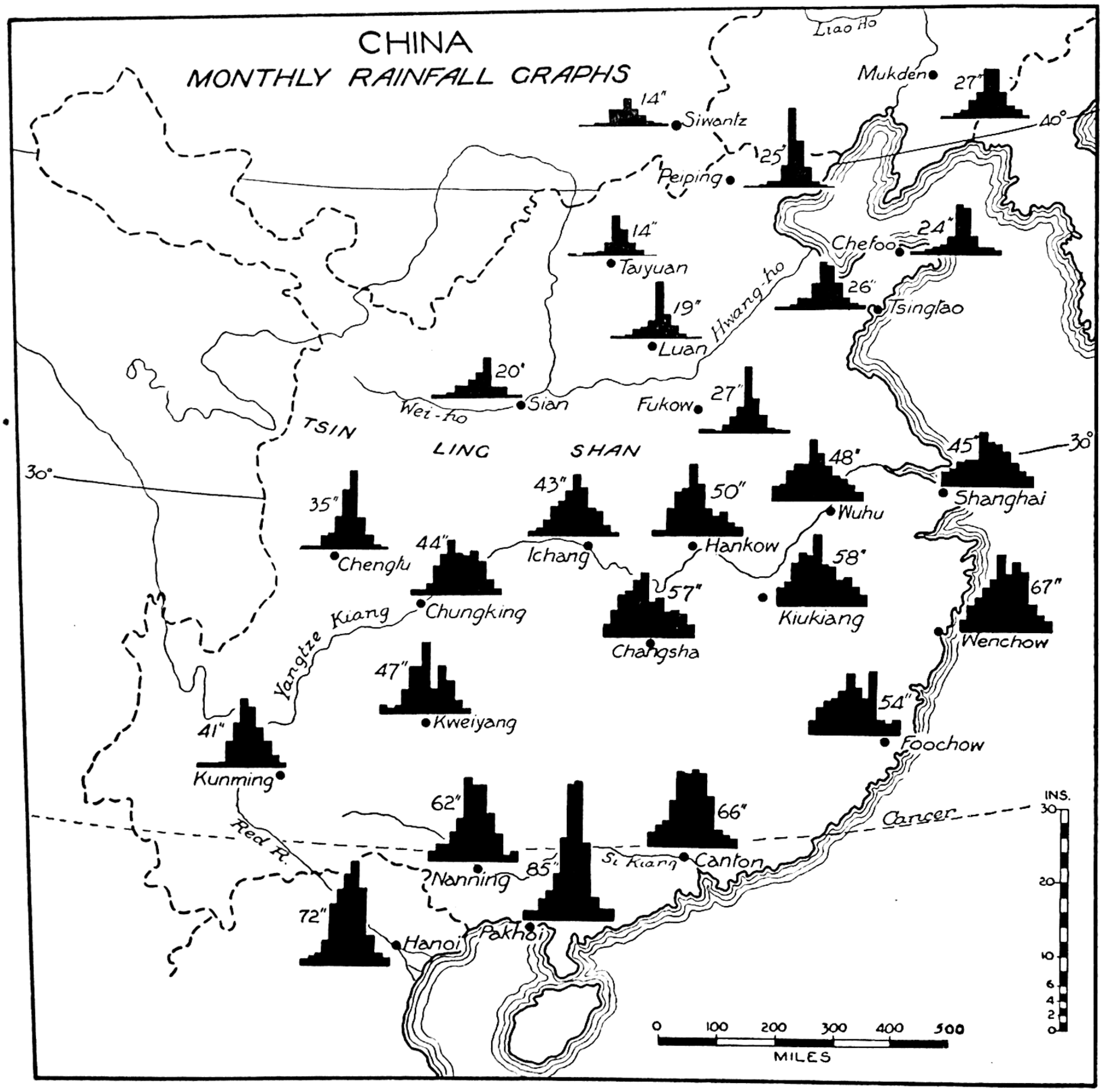

Fig. 36. Monthly rainfall graphs of China.

Within this rural framework there has developed a farming system similar to market-gardening in Western countries. Almost everywhere the agricultural landscape shows a small-scale pattern with tiny plots crowded on all available flat land and with terraces climbing the lower slopes of nearly all hilly regions. The system is intensive and aims at feeding the greatest number of mouths on the spot. Population pressure, combined with the division of land which has taken place through many generations, has resulted in small farms and a rather low productivity. Yet the Chinese farmers have by constant attention, unremitting toil and the application of the experience of centuries acquired a remarkable ingenuity in wresting a livelihood from the soil. Certain human qualities, such as their optimism and fortitude, their honesty and community spirit, have also helped them face recurrent calamities. This frugal, cheerful, patient and industrious peasantry is one of China's greatest assets.

The elaborate technique applied by the farmer varies in detail from region to region, but everywhere is designed to combine maximum production with conservation of fertility. There is a universal economy of materials, implements and space, and only time and labour are used on a prodigal scale. Where the natural conditions are favourable, the land is prepared by grading it to water-level. This checks erosion, retains water in the fields and replenishes them with fertile alluvial soil, which is washed down by the flood waters. The lower hills are often terraced up to the summits and the fields are graded and bounded by raised rims which retain the run-off until the sus-

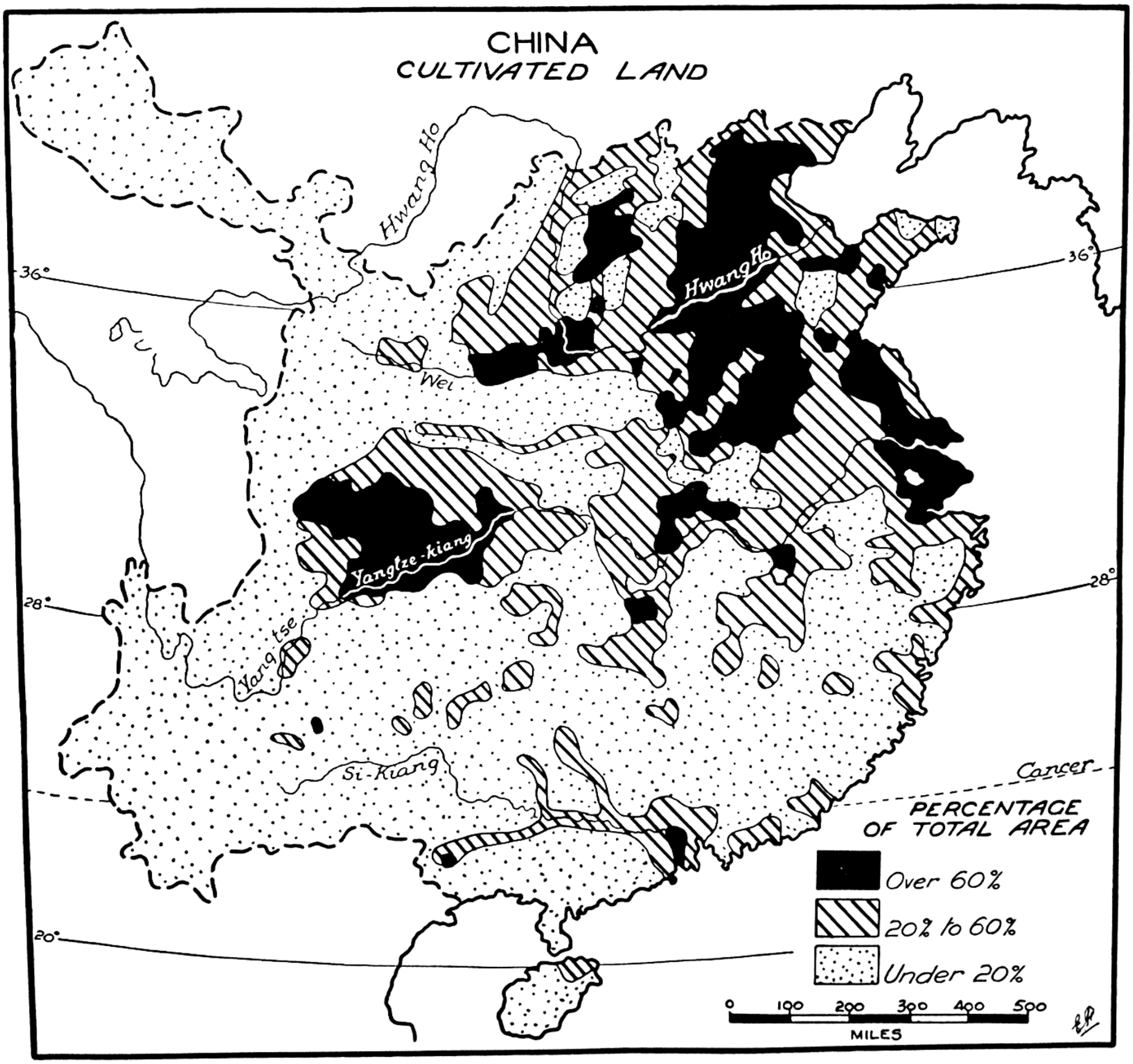

FIG. 37. Percentage of cultivated land in China.

pended sediments have settled. In Figure 38 some indication is given of the importance of irrigation in the Chinese farming economy. It will be noted that most of the irrigated land is in the wet south rather than in the sub-humid north, as the primary use of irrigation lies in supplementing the relatively abundant rainfall for the growth of an amphibious crop such as "wet" rice. There is therefore a remarkable increase in the use of irrigated land where rice begins to be the major crop.

Though few chemical fertilizers are used, the fertility of the land has been conserved with remarkable efficiency by using fully the waste of the human body

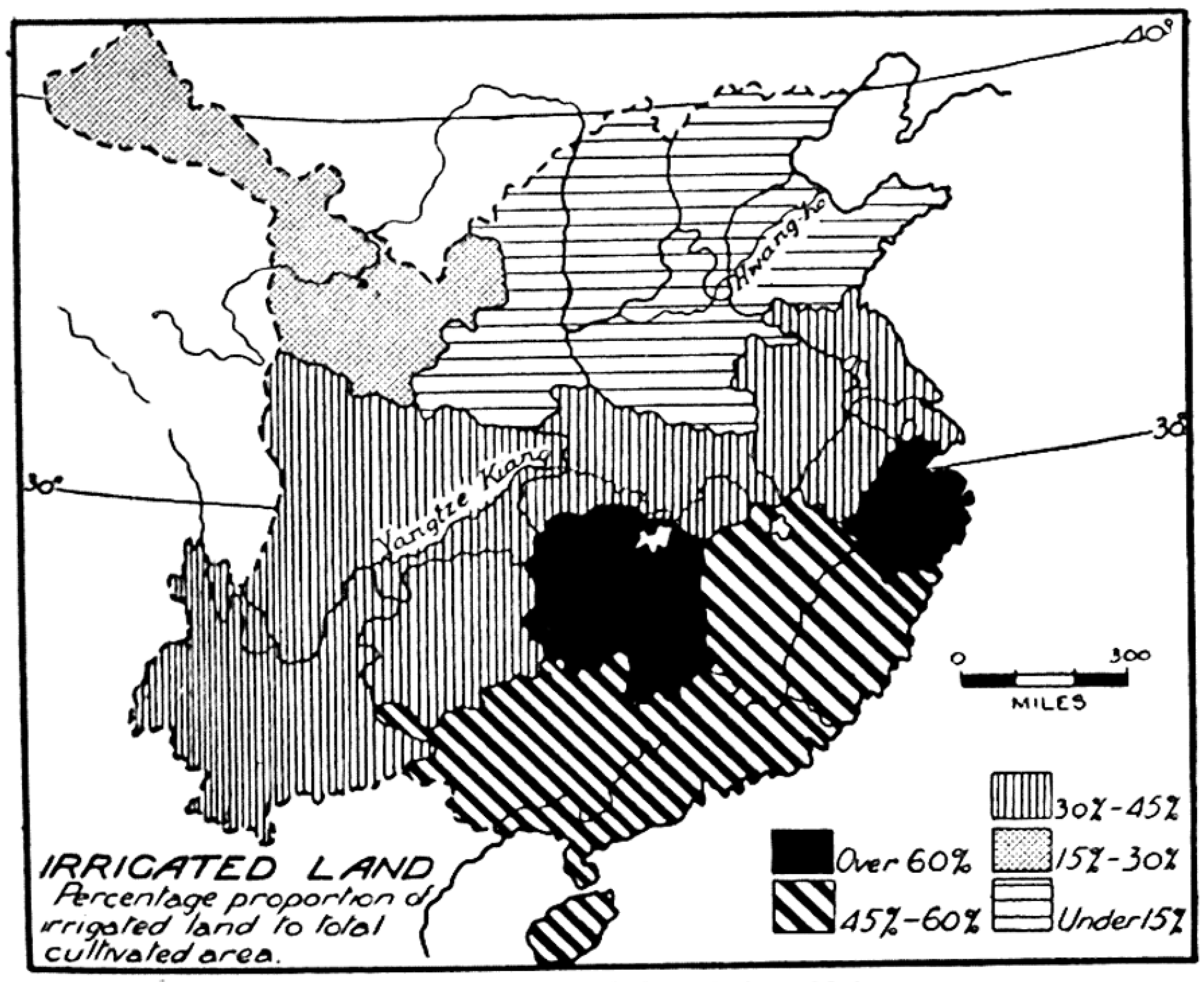

FIG. 38. Irrigated land in China.

(nightsoil), of animals (manure), of vegetables (humus), and even of fabrics. Given favourable conditions, the abundant labour supply makes multiple cropping possible and in the centre and south as many as three and four crops may be grown simultaneously. Figure 39 shows the subdivision of land and the crop types in a fertile portion of the Yangtze delta. Here rice and soybeans are grown for food and cotton as a cash crop. Note that this area, near the market of Shanghai, with its cotton mills, has much land under a cash crop. However, there are plots of maize, sweet potatoes, vegetables, melons and bamboo, all of which are used for food. Careful study of this diagram will show the close network of canals radiating from the three main canals. These main canals are the principal means of communication in the area. This is one of the more favoured areas of China, for natural fertility is great and there is little fear of flood and none of drought.

While the agricultural technique is elaborate and the use of the land is intensive, the Chinese peasant suffers from many handicaps. His capital resources are slender and his implements, of which the hoe and wooden plough are the chief, judged by Western standards, are primitive. In addition the excessive fragmentation of farms is common throughout the whole country. It is estimated that two-thirds of the farms have an average parcellation of five; and one-fifth from six to ten parcels. The parcels themselves are divided into fields, and there is an average of twelve fields per farm. This parcellation of the land, as well as increasing the difficulties of farming, places many obstacles in the way of agricultural progress. Much land is used in needless boundaries, scattered fields are difficult to manage, and the application of modern machine cultivation is impracticable. Figure 40, showing the fragmentation in a simple valley settlement in Kiangsu, illustrates this feature. It was selected because the restrictive terrain limited the area available for agriculture and therefore made it easier to follow the pattern of parcellation. You should use the scale to see how much walking is involved by each farmer in attending to his plots.

The success of the farming system depends on individual skill and a large labour supply, which supplies the muscle-power where machines are absent. A serious economic defect of the system is the under-employment of the labour force. Not more than one-third of the able-bodied men are engaged in full-time work. It is only at sowing and harvest time that the demand for labour is heavy, and the great labour surplus throughout much of the year is a basic cause of mass poverty in rural China.

If agrarian China is over-manned it is under-capitalized. Agriculture under the best of conditions is an industry of slow turn-over. Where incomes are small and margins narrow, as in rural China, the peasant must find some means of tiding over the interval between sowing and harvesting. Shortage of money to purchase the bare necessaries during this period forces him into the clutches of the money-lending class. It is common to find crops pawned in the summer, farm implements in the winter and household belongings at all seasons. The rates of interest vary from a moderate 25 per cent to a normal 40 per cent, and at times are as high as 200 per cent. One of the greatest needs in rural China is the establishment of rural credit through banks or rural co-operative societies, which would provide money at reasonable rates of interest.

A further feature of this mass poverty and general indebtedness is the allotment of nearly all the farm income for the provision of a minimum requirement of food. There is little margin anywhere for education and recreation, or as a reserve for bad years, and houses are small and often insanitary. Peasant clothing, consisting of cheap cotton goods, is mostly inadequate.

The regional division of agriculture used in Figure 41 is based on that of Professor J. L. Buck in his *Land Utilization in China: Atlas*. It shows a close correlation with the physical and climatic regions and gives a much more intelligible view of Chinese agriculture than a survey by provinces. The fundamental distinction between the wheat region and the rice region corresponds with the major physical division between the north and south formed by the Tsin-ling Shan. The north is essentially a region of "dry" crops, such as millet, kaoliang and sorghum, with wheat everywhere dominant. The farms are large by Chinese standards, and animals, such as the mule, donkey, oxen and sheep, are frequently part of the farm economy (see Figures 43 and 44). The green south, on the other hand, is a land of "wet" crops and of double (sometimes treble) cropping, with rice dominant in the lowlands and the water-buffalo the characteristic farm animal.

The different types of rural economy make possible a division of the wheat and rice regions into eight areas (see Figure 41):

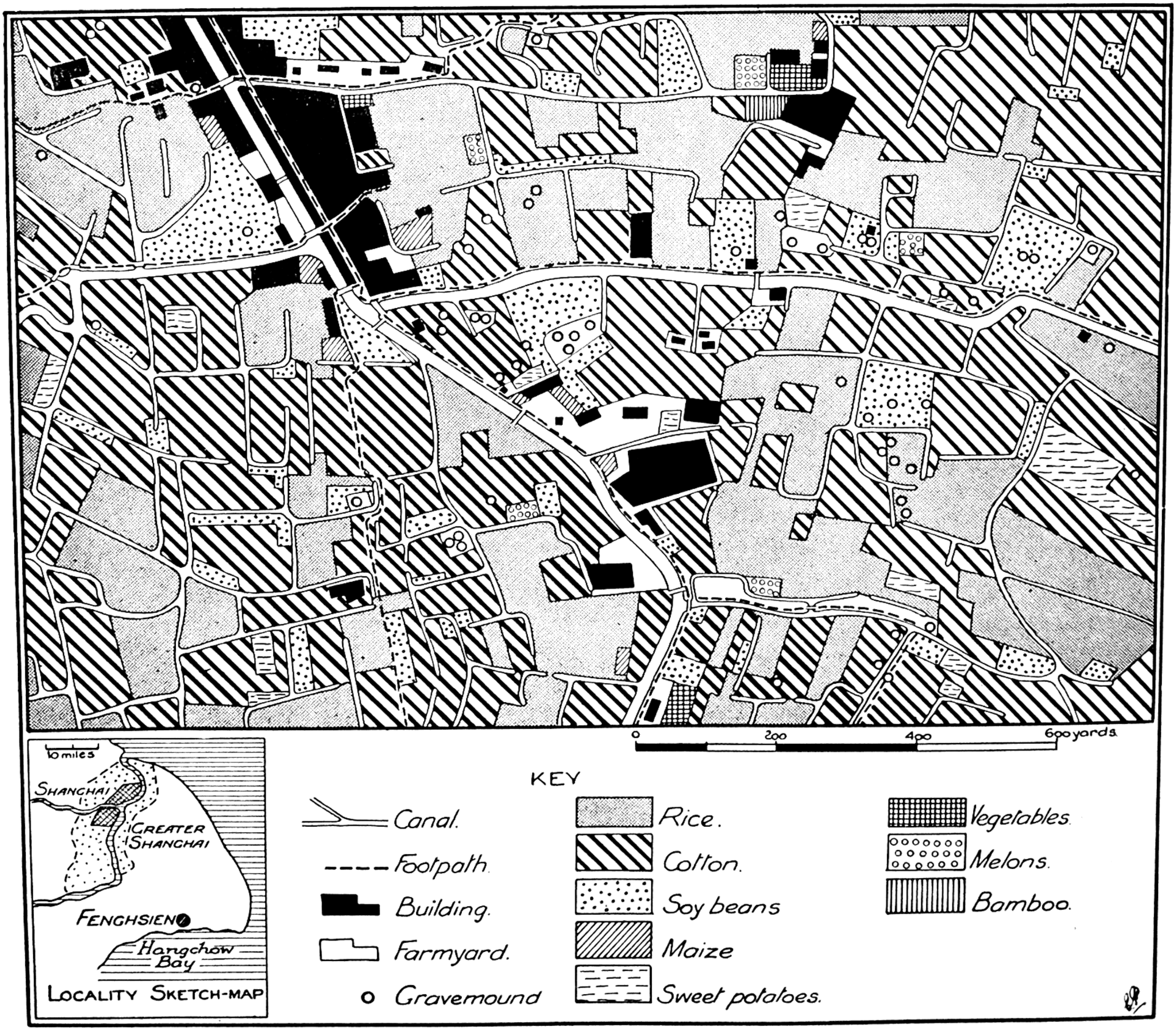

FIG. 39. Land utilization in the Fenghsien area of China.

A. The wheat region.

1. The spring wheat area.
2. The winter wheat–millet area.
3. The winter wheat–kaoliang–soybean area.

B. The rice region.

4. The Yangtze rice–wheat area.
5. The Szechwan rice area.
6. The rice–tea area.
7. The double-cropping rice area.
8. The south-western rice area.

1. The spring wheat area: The physical conditions in this long band of country are difficult, since a high proportion of the land is too rugged or too dry for cultivation. The rainfall is low and the growing season limited to about five months. The characteristic crops are millets, potatoes, and spring wheat with a less important production of oats, kaoliang and the opium poppy. This is one of the few areas of China where prospects for animal husbandry are good and sheep are common. Future development is likely to be in the direction of livestock, as the agriculture has already passed the safe limits in many places.

2. The winter wheat–millet area. This comprises the greater part of the loess plateaux. The productivity of the land is limited by the low and erratic rainfall and by the physical property of the loess, which renders it liable to rapid erosion. Winter cropping is considerable (40 per cent) and double cropping is becoming more important. The characteristic crops are winter wheat, millet, kaoliang, cotton and maize. Maize is chiefly a spring crop, the millet a summer crop planted after the winter wheat. Cotton and kaoliang are spring-planted crops. Rice and cotton are important in warm, sheltered valleys. Extensive development of irrigation is necessary to ensure a safe agricultural future in this region.

3. The winter wheat–kaoliang area. This covers the Great Plain of North China. The rainfall is about 25 inches a year and there are seven months free from frost. The major portion of China's wheat is grown here as a winter crop, being harvested in May and June. The spring crops are kaoliang, millet, soybeans and sweet potatoes. Rice and cotton are grown in favoured regions and fruits are important in the Shantung peninsula. The future of farming here depends on solving the colossal problem of the control of the Hwang-ho.

4. The Yangtze rice–wheat area. This covers the flat or undulating plains of the middle and lower Yangtze. Here there is an ample rainfall, high temperatures for seven months of the year and a high humidity, so that there is almost a continuous growing period with a short resting period in the winter. Two crops are usually grown: (*a*) the "dry" crops such as wheat, barley or beans in the pre-monsoonal period and (*b*) the "wet" crops, primarily rice, grown during the summer monsoon and harvested in the autumn. Cotton is

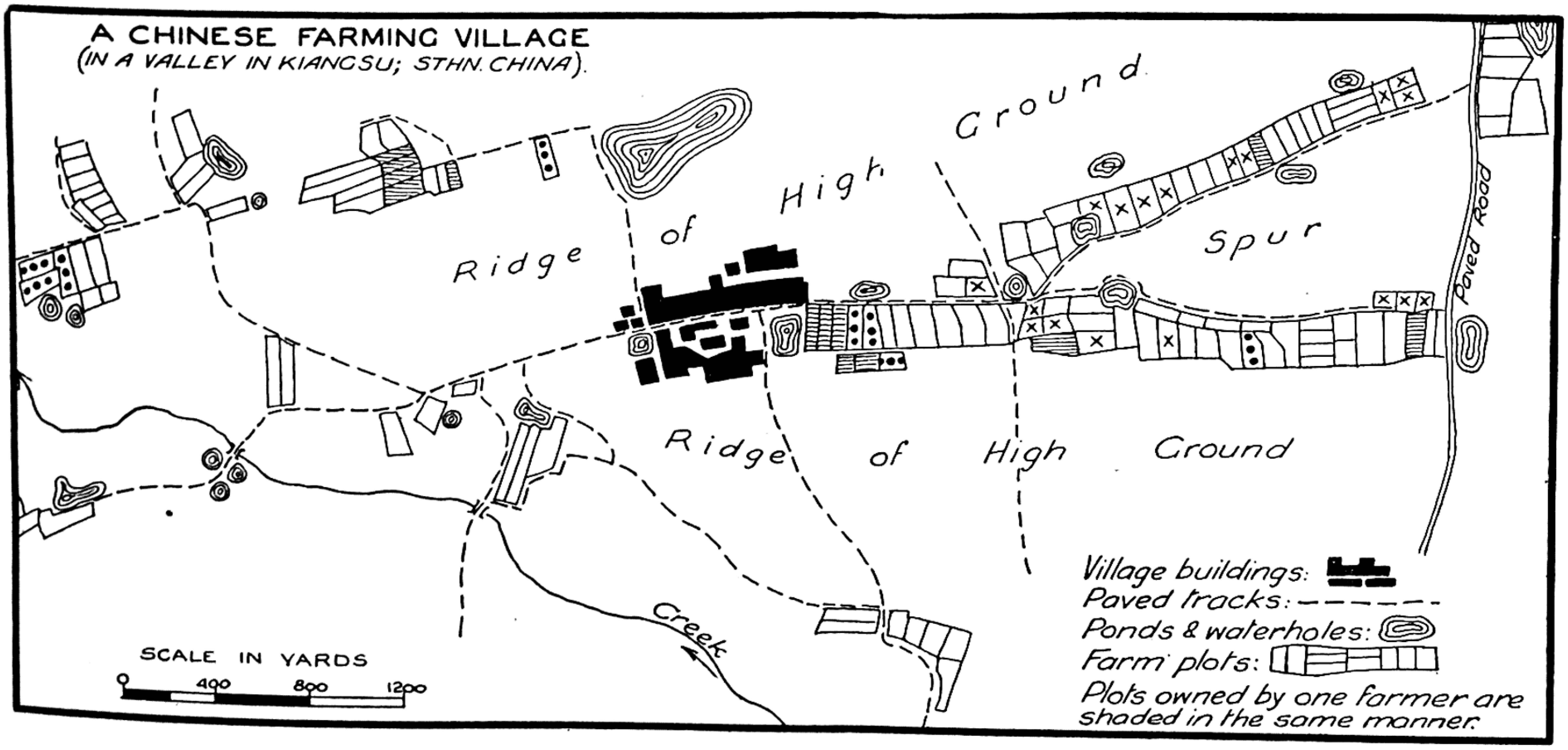

FIG. 40. Sketch-map of a Chinese farming village (*After Jones and Darkenwald*).

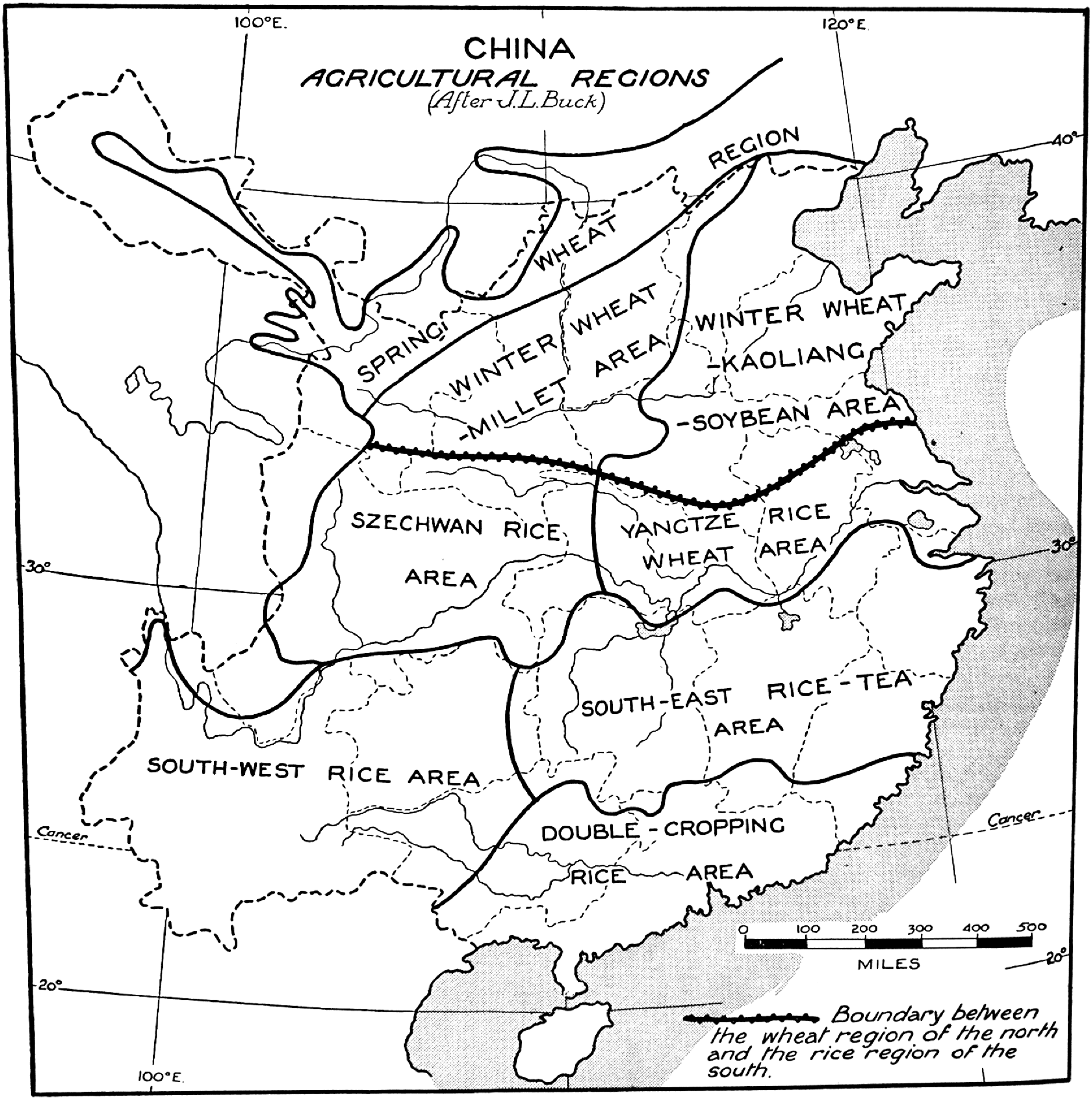

FIG. 41. Agricultural regions of China (*After J. Lossing Buck*).

an important commercial crop in much of the area (see Figures 34 and 39).

5. The Szechwan rice area. This occupies the famous Red Basin, which is sheltered and has a favourable southerly aspect that gives it the full advantage of warmth and sunshine. The rainfall is abundant and the high humidity allows the cultivation of a great variety of crops, of which rice is the chief. Winter crops include opium poppy, rape seed, and wheat. Spring crops are part of the rice and part of the maize crop. Summer crops are usually rice and maize. In the Chengtu plain the variety and intensity of agriculture reach great heights.

6. The rice—tea area. This is a region of rolling hills with some limited lowlands along the rivers and round lakes Tungting and Poyang. The soil basis is poor but the high humidity and good distribution of rainfall are favourable for rice and tea crops. The mist which forms on the hills is responsible for the development of the best teas. The growing season is normally about nine months and the coastal areas are almost frostless. The type of farming is rice and rape seed with rice dominant, and tea an important crop on favourably placed hill slopes. The amount of double cropping is high, with winter cropping more important in the northern parts.

7. The double-cropping rice area. This is China's subtropical region. The topography is hilly but the climatic conditions, with a good growing temperature throughout the year, a well distributed rainfall and a high humidity, are very favourable. This is preeminently a rice region with double and sometimes treble cropping. Tropical fruits, lychee fruits and oranges are very common throughout the area. There is also a production of sugar-cane (see Figure 34) and medicinal plants such as cinnamon and ginger.

8. The south-western rice area. This comprises the high plateau covering most of Kweichow and Yunnan. The climate, because of its near-tropical position, is equable, with a long growing season. The topography is very difficult and as a result the proportion of cultivated land is the lowest for all the cultivated units surveyed. The main crops are rice followed by broad beans, maize and wheat. The prospects for future development are good provided improved means of transportation are available. There are considerable areas of unutilized grazing lands and large forests capable of supporting timber industries.

Summary. In a country which is so largely devoted to arable farming it is natural that a considerable variety of crops should be produced. The principal crops are those which can be used for human food, especially grains, beans and vegetables. Little land is available for the growing of fodder to be used in the feeding of animals, even where they are kept for draught purposes. The country is not self-supporting in essential foodstuffs and there is considerable import from overseas. There is also an important production of commercial crops such as cotton, silk, tobacco and opium, which are partly used on the farm and partly sold for cash.

Animals. Throughout the discussion on agriculture it was stated several times that animal husbandry is of little or no importance in China, except in the north-west. This does not mean that there are practically no animals in China. It is meant rather to convey the impression that animals are not an integral part of the farm economy in the same way as they are in England, in the corn-belt of the United States, or in the wool-wheat belt of New South Wales. In China animal husbandry is for the most part a side-line of arable farming.

Draught animals like oxen, water-buffalo, horses, mules and donkeys are reared for cultivating and for transport purposes. Swine are raised in large numbers and, together with poultry, seem to be found on every farm, being used as a source of fertilizer and partly as the basis of the meat supply. In the drier marginal lands of Mongolia and Tibet, animals form the basis of the livelihood of the nomadic herdsmen living there (see Chapter 3).

The estimated numbers of various livestock and poultry on farms in China in 1936 were:

	Millions		*Millions*
Pigs	60	Donkeys	10
Water Buffalo	11	Goats	18
Oxen	22½	Sheep	14
Horses	3½	Hens, ducks and geese	310
Mules	4		

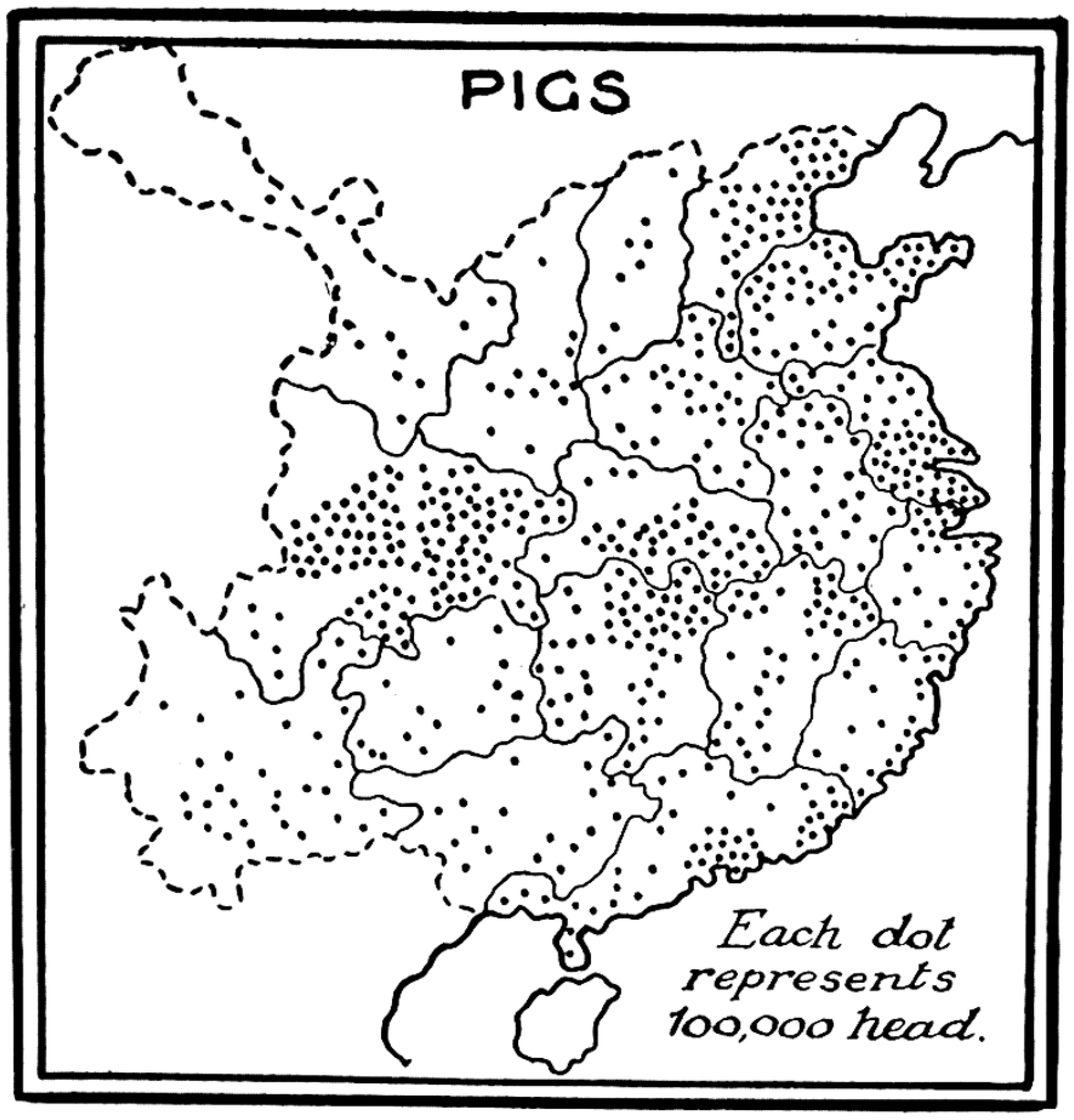

Fig. 42. Distribution of pigs in China.

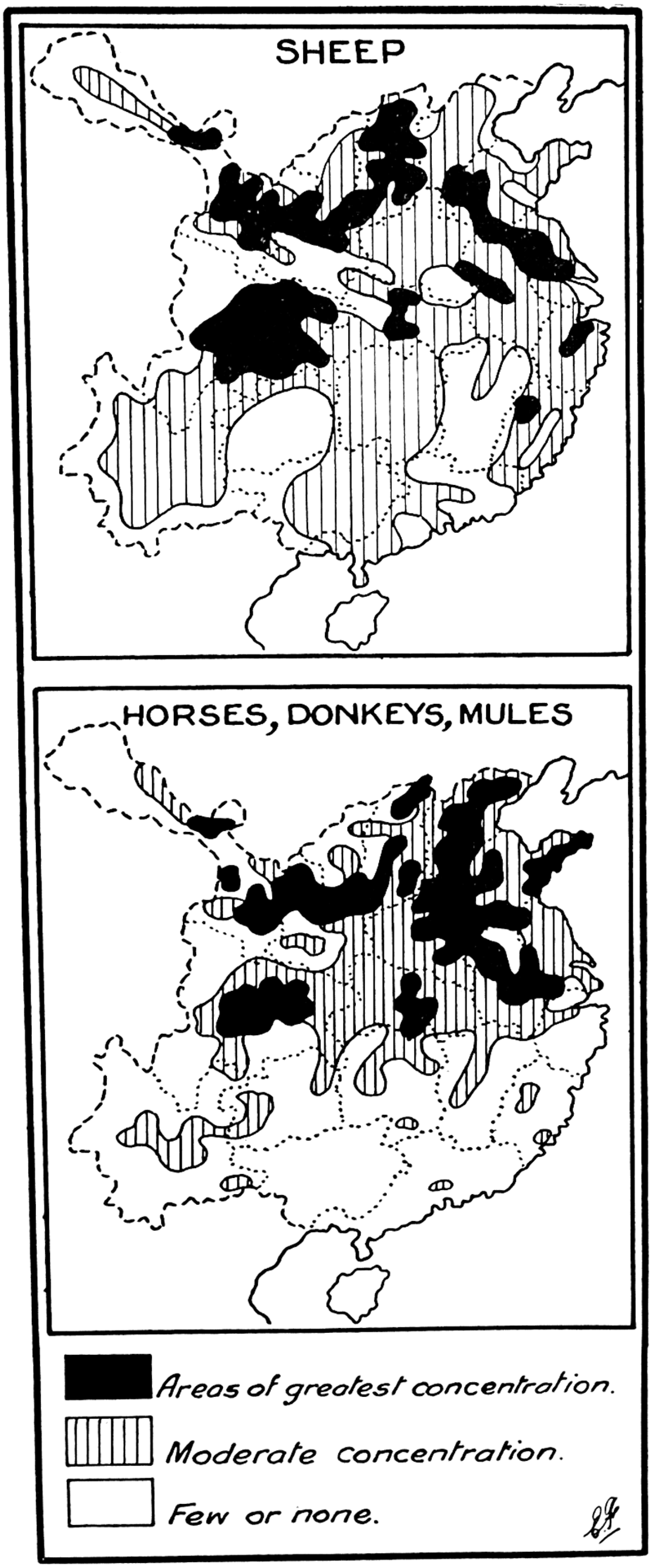

FIG. 43. Distribution of sheep, horses, donkeys and mules in China.

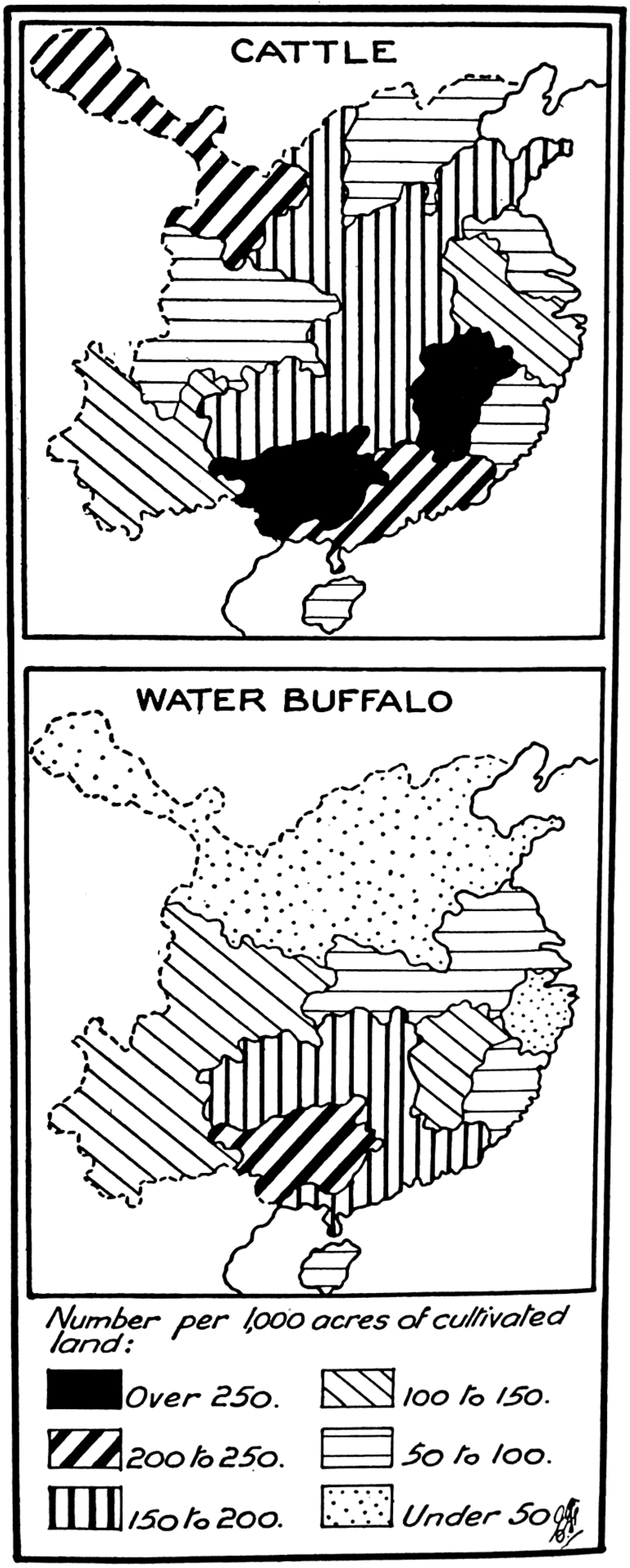

FIG. 44. Distribution of cattle and water buffalo in China.

Figures 42, 43 and 44 show the general distribution of some of these.

1. Water buffalo and oxen. The main concentration of cattle is found in the central and southern provinces, where the stolid water buffalo is adapted for work in the rice fields. Elsewhere cattle give way to horses, a change due mainly to difference in climate and to differences in the types of work demanded of the animals.

2. Horses, mules and donkeys. These are of minor importance in the south and are used chiefly for riding purposes in the north. Mules and donkeys are also used as draught animals on the farms and on the roads.

3. Sheep and goats. These are both of a rather poor quality and are raised mainly in the northern provinces, where their wool and mohair are a source of income for the farmers, as well as being used for cloth-making in the homes.

4. Pigs. China probably has the world's largest swine population. Although found in all parts of the country, the areas of greatest concentration occur on the Great Plain and in the Yangtze valley (see Figure 42). The pigs are fed on refuse only and their manure is highly valued by the farmers. The animals are used for supplying meat and for pig bristles, an industry in which China dominates the world.

5. Poultry. Poultry are widely distributed and eggs are everywhere an important item of diet. There is also a large export of egg products.

6. Fishing. Unlike Japan and the countries of tropical south-east Asia, China is not a very important fishing country. Whereas in the former areas fish is a staple diet in conjunction with rice, in China it is merely supplementary to the main vegetable foods. In the Yangtze delta and the Si-Kiang valley fish culture in ponds is an important industry, the fish being used for food and as a source of income by the farmers. Silk farmers work in with the fish farmers, since the waste from the cocoons is fed to the fish, and the mud from the bottom of the ponds is spread as manure round the mulberry trees.

JAPAN

Landforms. 1. Japan consists of four large islands forming part of the gigantic folds which make a series of festoons and arcs off the mainland of Asia (see Figure 45). These folds are flanked on the Pacific side by deep trenches in the ocean floor, and on the continental side by seas of varying depth, that to the west of Japan being over 12,000 feet deep.

2. The whole area has thus a mountainous and insular character in which the areas of lowland are narrow in form and limited in extent (see Figure 46). Owing to the comparative youthfulness of the folds and the great difference in elevation between the mountain backbone and the ocean deeps to the east (some 35,000 feet), the islands are physiographically very unstable and suffer from frequent earthquake shocks, some four every day on an average. The crustal instability is also indicated by the presence of over 500 volcanoes, of which about 60 have been active in historic times.

(*a*) **The mountain area** is characterized by steep slopes, very rugged topography and sharp angular peaks and ridges. These forms are due to the recent and rapid uplift of the area followed by vigorous stream erosion. The mantle of soil and weathered material on these slopes is thin and over 75 per cent of the country is hilly or mountainous with slopes exceeding 15°, too steep to be tilled.

The mountain streams are short, swift and shallow with small and steep drainage basins. Of little value

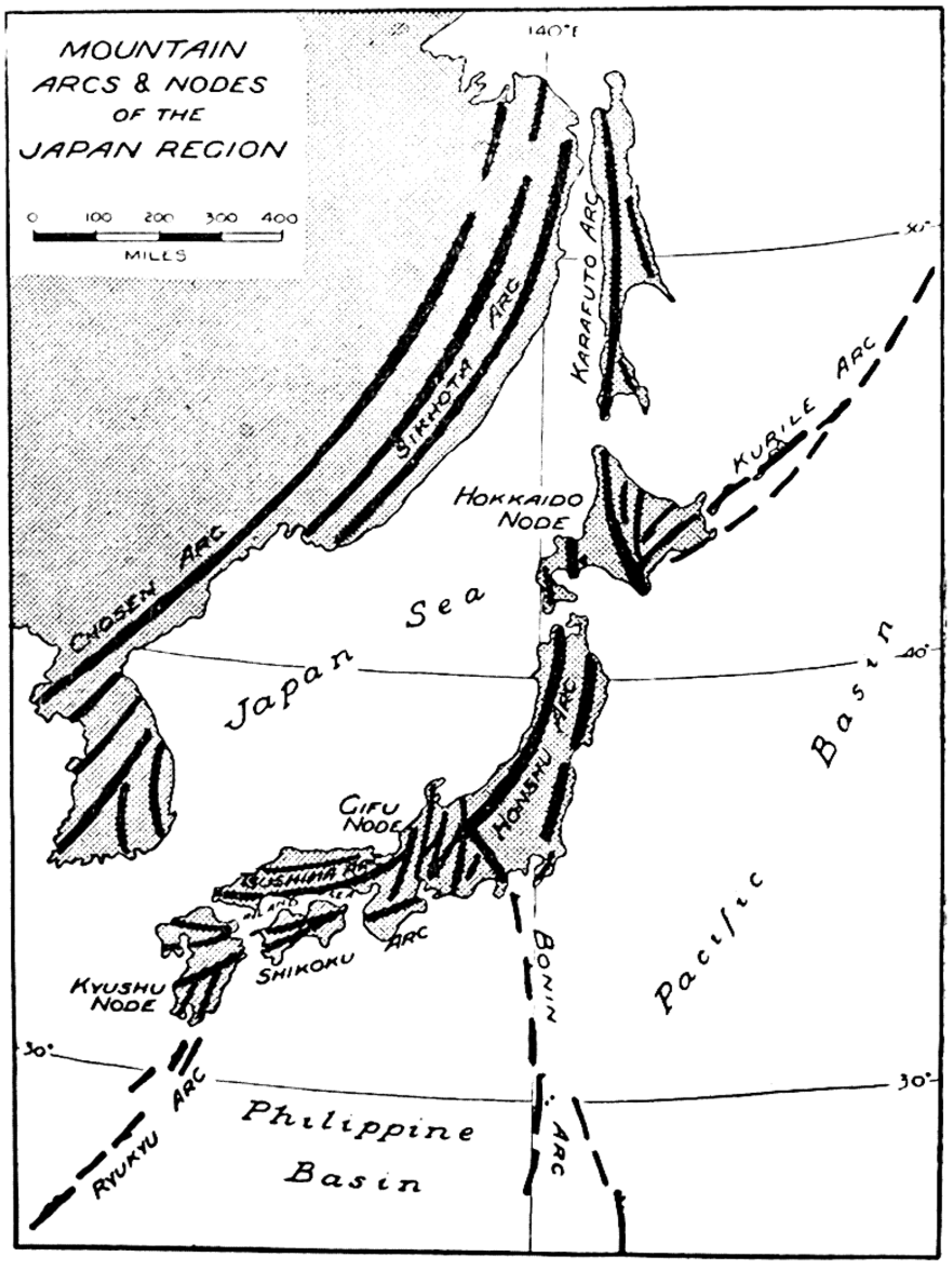

FIG. 45. Main mountain arcs of the Japanese region.

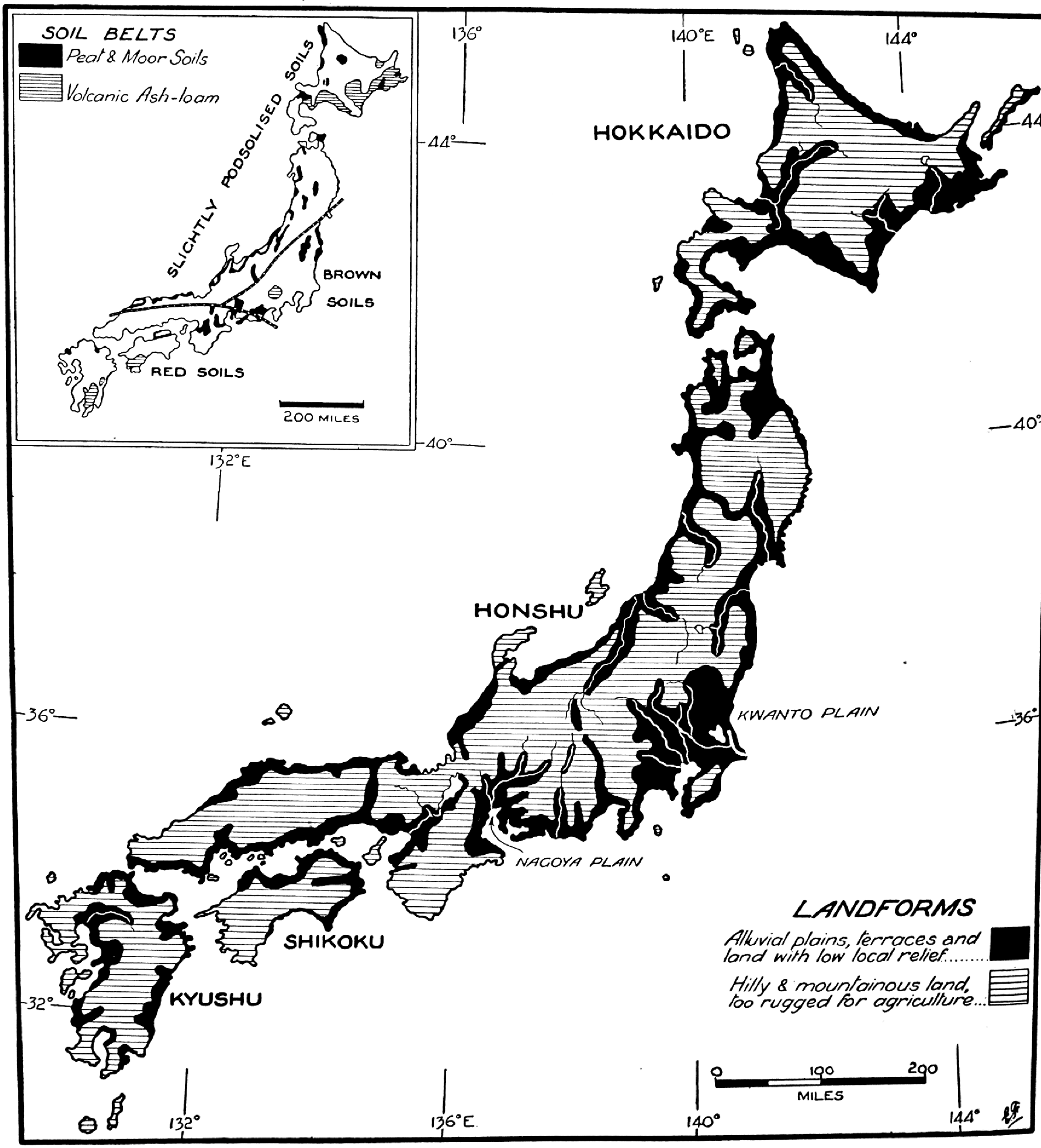

Fig. 46. Landforms and soil belts of Japan.

for navigation, they have been used to generate power in hydro-electric schemes and to supply irrigation water to the rice fields of their valley plains.

(*b*) **Lowlands.** There are no extensive lowlands in Japan and the areas shown on Figure 46 consist of patches of river sediments along the coasts and in mountain valleys. The largest of these are the Kwanto Plain (5,000 square miles) and the Nagoya Plain (3,000 square miles).

Most of the plains consist of alluvial fans with coarse sands and gravels near the bordering mountains and fine silts farther out towards the sea-coasts. Rivers on these plains are shallow and braided and they are mostly flanked by levees. Such elevated streams are an asset in that water is easily distributed from them for irrigation; but they are a liability if they break their banks during flood periods.

Much of the lowland area of Japan consists of older uplifted plains composed of sands and gravels and known as diluvial terraces. Because of their greater elevation, which makes irrigation difficult, and their poor soils, they are much less extensively used for cultivation than the lower plains of newer alluvium. Rice is rarely grown on diluvium, its place being taken by wheat, barley, mulberry, tea, orchards and vegetables.

(*c*) **Coastlines.** The unusually long coastline of 17,000 miles coupled with the fact that many of the lowlands face the sea, has given the Japanese people a marked maritime outlook. The adjoining seas, where warm and cold ocean currents meet, and where large rivers such as the Amur and Yangtze-kiang bring much land refuse, teem with edible fish. The Japanese have therefore always used fish as a major item in their diet (see Figure 51).

3. The landforms of the islands are thus of great importance in determining the mode of living in Japan. The two dominant aspects are the restricted extent of level land and the insularity. These force the Japanese either to farm the land on a most intensive pattern or to become fishermen.

Soils. On the whole the soils of Japan do not exhibit a mature character. This is because of the considerable erosion from the mountain and hill lands and the new character of the alluviums developed on the plains. In general, the soils are not particularly fertile because they are leached of plant food elements by erosion, whilst the mixed character of the soils on the plains causes great variability there. Figure 46 (inset map) shows the distribution of the principal soil types.

Climate. The climate of Japan resembles that of central China in many of its features, but, at the same time, shows the effects of insularity and the presence of a high mountain backbone.

1. Within the islands the irregular topography introduces sharp vertical contrasts in the climates of small areas. This is reflected in rapid changes in land use from valley floors up the adjoining hill-sides.

2. In general, the summer conditions resemble those of other lands in similar latitudes, e.g. coastal New South Wales; but the winters are much colder than such lands, for Japan then comes under the influence of the biting off-shore Asian monsoons, whose low temperatures are only partly modified in crossing the Sea of Japan.

3. The on-shore south-east to east summer monsoons bring rains to all parts of the islands, but particularly to the eastern side, where the winds meet the mountain barrier. In winter, the off-shore monsoons bring considerable rains and heavy snowfalls to the western side of the islands, while winter cyclonic storms from the Yangtze valley give some rains to the southern shores.

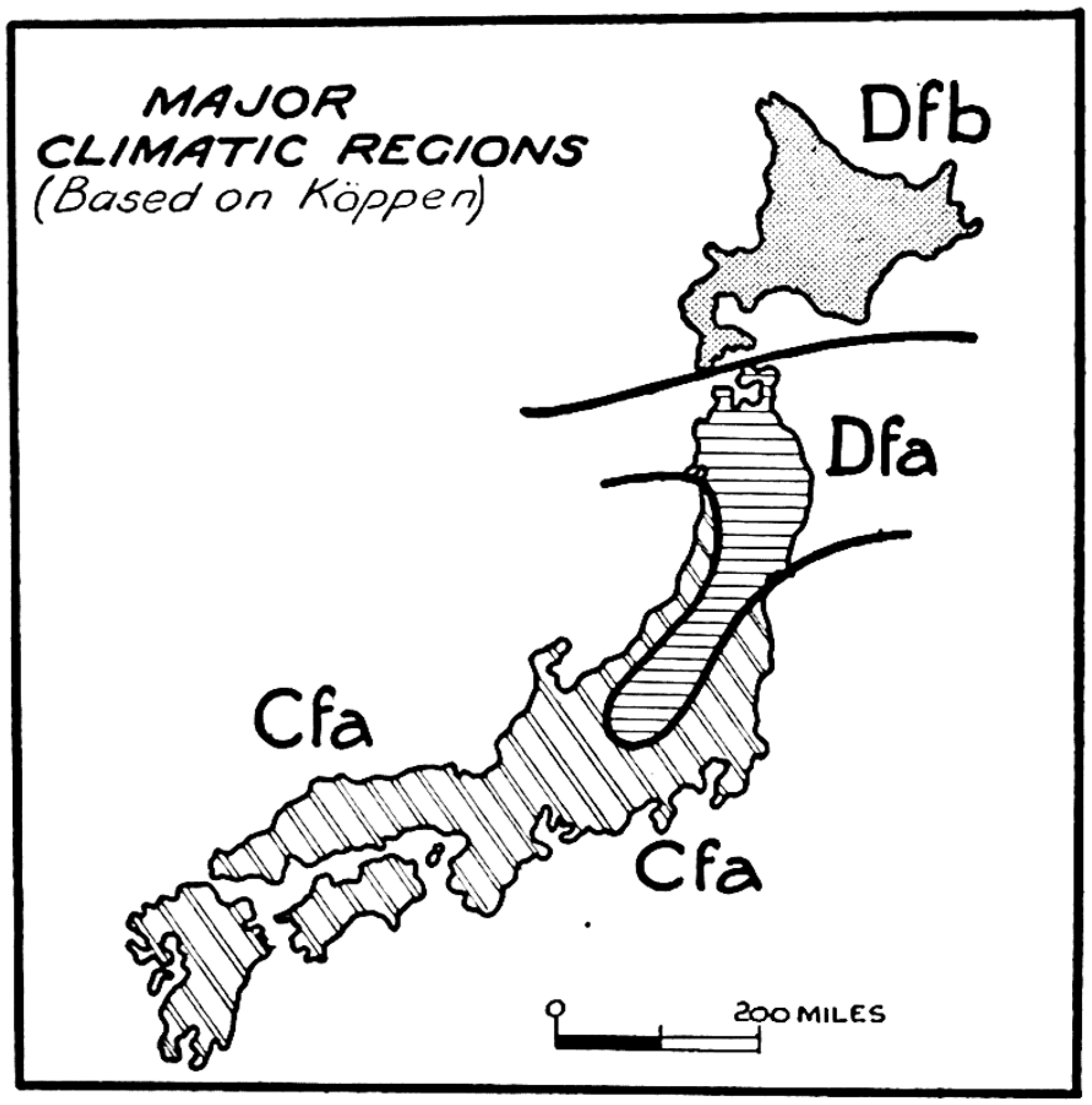

FIG. 47. Major climatic regions of Japan.

4. The rainfall is everywhere abundant for all forms of crop growth (except rice, which must be irrigated to maintain a depth of six to eight inches of water on the growing plants) and the climate may be described as a moist one.

5. The frost-free period, which is essentially equal to the growing period, ranges from four months in Hokkaido to eight months in southern Honshu and Kyushu. Thus, two crops of rice may be grown in the extreme southern portion (see Figure 50).

6. Figure 47 shows the distribution of the major climatic regions based on the Koeppen classification. Attention is drawn to the demarcation of Hokkaido from the rest of the islands and the marked loop in

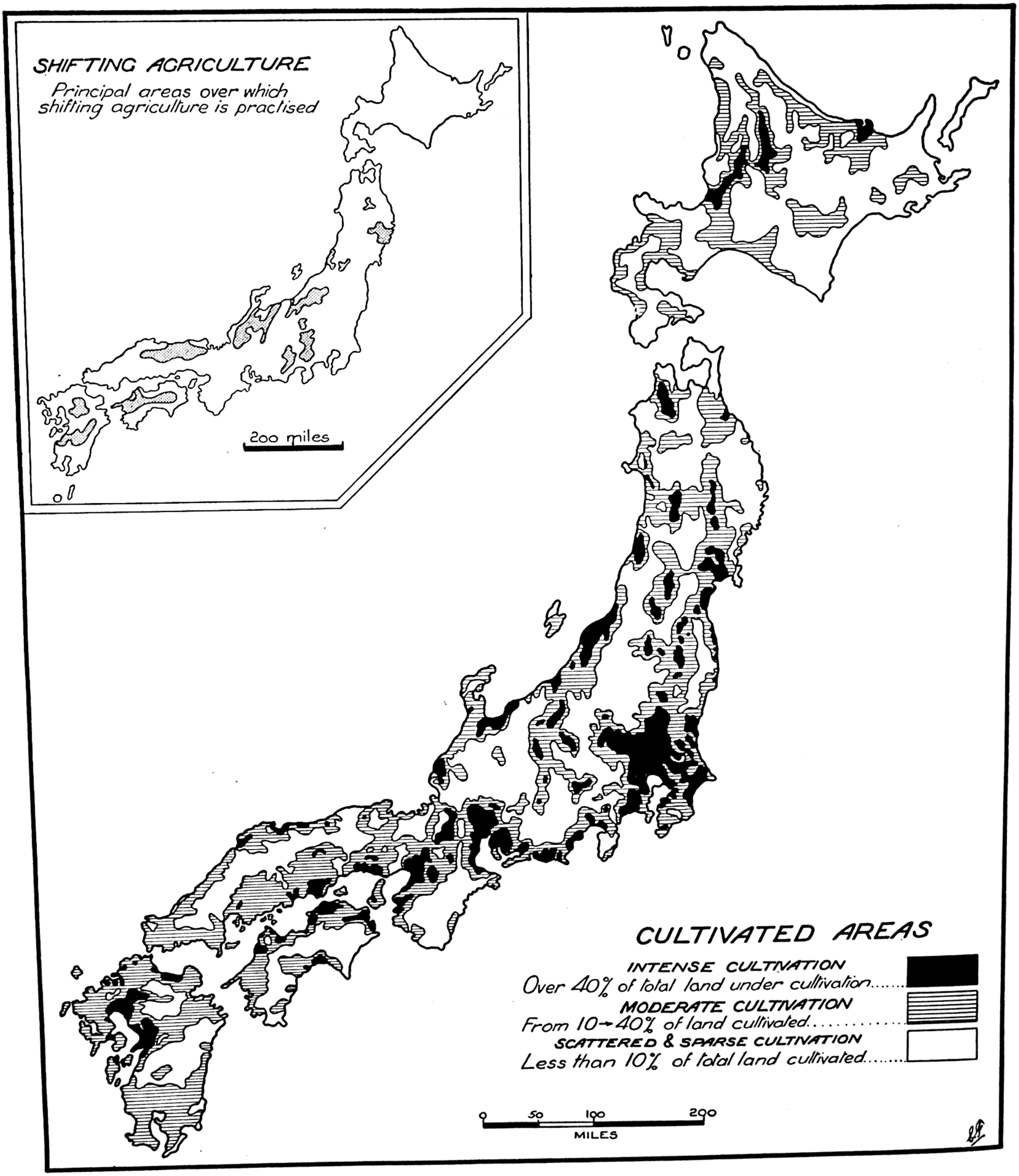

FIG. 48. Cultivated areas of Japan (*After Trewartha "Japan"*).

the boundary between *Dfa* and *Cfa* types. This boundary is the 32° cold month isotherm and is intended to indicate the distinction between the mild and the more severe types of climate.

(*a*) The *Dfb* climate. The two major characteristics of Hokkaido are its relative dryness (its 40 inches of rain a year making it the driest section of Japan) and the absence of bright sunshine for considerable portions of each year. The dullest periods are in the winter, when the winds from the mainland create cloudy conditions, and in the summer months, when dense fogs occur along the east coast due in large measure to the effects of the cool Arctic currents.

The summers are cool and short and the winters long, cold and marked by heavy falls of snow. At least four months have temperatures below freezing point, ranging from 23°F. down to 3°F.

(*b*) The *Dfa* climate. The general features here show variations from place to place due to the highlands with their mountain basins and location on either the eastern or the western coastlands. The winters are mostly periods of high rainfall, heavy snow, strong winds and a large number of cloudy days. The summers have relatively high temperatures and a humidity which produces sultry weather. The summer monsoons bring from 40 to 60 inches of rainfall.

(*c*) The *Cfa* climate. The outstanding feature of this region is its high annual rainfall, which rises to over 80 inches a year in many places.

The winters are mostly severe, for although the average temperatures do not fall below freezing point, the normal sunny weather is often interrupted by a series of very cloudy days with raw winds and penetrating cold. On the Sea of Japan coast the heaviest rainfall of the year occurs at this period and the snowfall may be deep and lasting. The summers are a period of maximum rainfall for most of the *Cfa* areas, and the high temperatures and high humidity produce a sultry season. As a result it is especially enervating, but it is important from the agricultural point of view, giving a growing season of up to 250 days on the south-western sections of the islands.

Agriculture. 1. Examine Figure 48 carefully and compare it with Figure 46 to see how closely the Japanese farmers cling to the lowland areas. Notice also the great agricultural importance of the Kwanto Plain and the Nagoya Plain. Here (as elsewhere near large urban populations) the farming is not truly subsistence farming, for the farmers all strive to produce some surplus of food crops for sale to the city populations. It is away from the city influence that the truly subsistence farming people live, there being even some shifting agriculturists in mountainous and remote areas.

2. In 1939 the cultivated land in Japan represented 17 per cent of the total area of the country (i.e. about 15,000,000 acres). On this area some 5½ million farming families lived, so that each family had an average of 2·7 acres from which to wrest a livelihood.

3. The principal crops in 1939 (with the percentage ration of their area to the total cultivated area) were rice (40); barley (9½); wheat (9); vegetables (7); mulberry (6½); green manures (6); beans (5); oats, millet, maize and buckwheat (4½); industrial crops (4); sweet potatoes (2); others (3).

4. The tiny farm is nearly always composed of several small unfenced plots scattered at varying distances and in different directions from the village wherein the farmer lives. Figure 49 shows the land utilization adjacent to a typical Japanese village and from it you should note the following points:

(*a*) The scale of the map. It is important to appreciate how small (or large) each farm plot really is. Measure it and compare it with some area familiar to you, such as a tennis-court or your home garden.

(*b*) The scattering of the plots owned by Farmer "F". He owns eight plots in all and their management entails much wasted time in walking to and from them. Their size prevents the use of any implements except the spade or hoe.

(*c*) The closely packed houses in the village, so arranged as to use a minimum of land which might grow crops.

(*d*) The "dry" crop areas on the low ridge running down the centre of the area.

(*e*) The school. This is a recent addition to an old farming area and an indication of the efforts of the Japanese Government to spread education throughout the country.

(*f*) The preponderance of rice-growing throughout the area.

(*g*) The irrigation channel on the east and the drainage ditch on the west.

5. The farming in much of Hokkaido is on a different pattern from that over the rest of the islands, for much of this island has been recently developed and the farming has been modelled on American lines with larger farms, mostly in one piece, and worked with the aid of some machinery and animals.

6. **Agricultural practices.** (*a*) Japanese agriculture is characterized by several distinctive features, some of which are found in the other lands of south-east Asia; but others are peculiar to Japan.

(*b*) As in China, agriculture is very intensive but comparatively unscientific. The tiny scattered fields prohibit the use of agricultural machinery and waste the farmer's time in going from one to the other. The overwhelming concentration on rice as a food crop

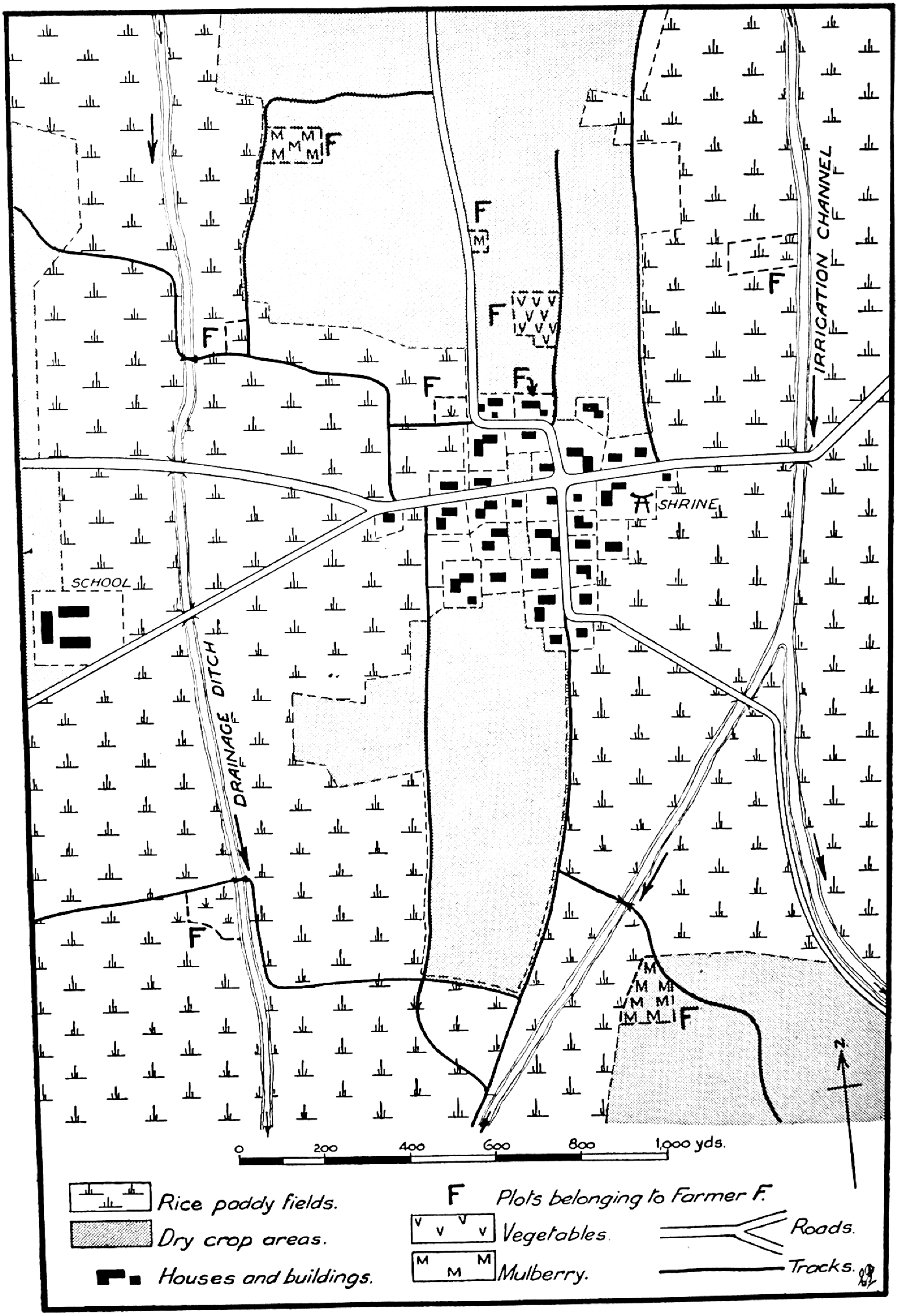

FIG. 49. A Japanese village farming area (*After Trewartha*).

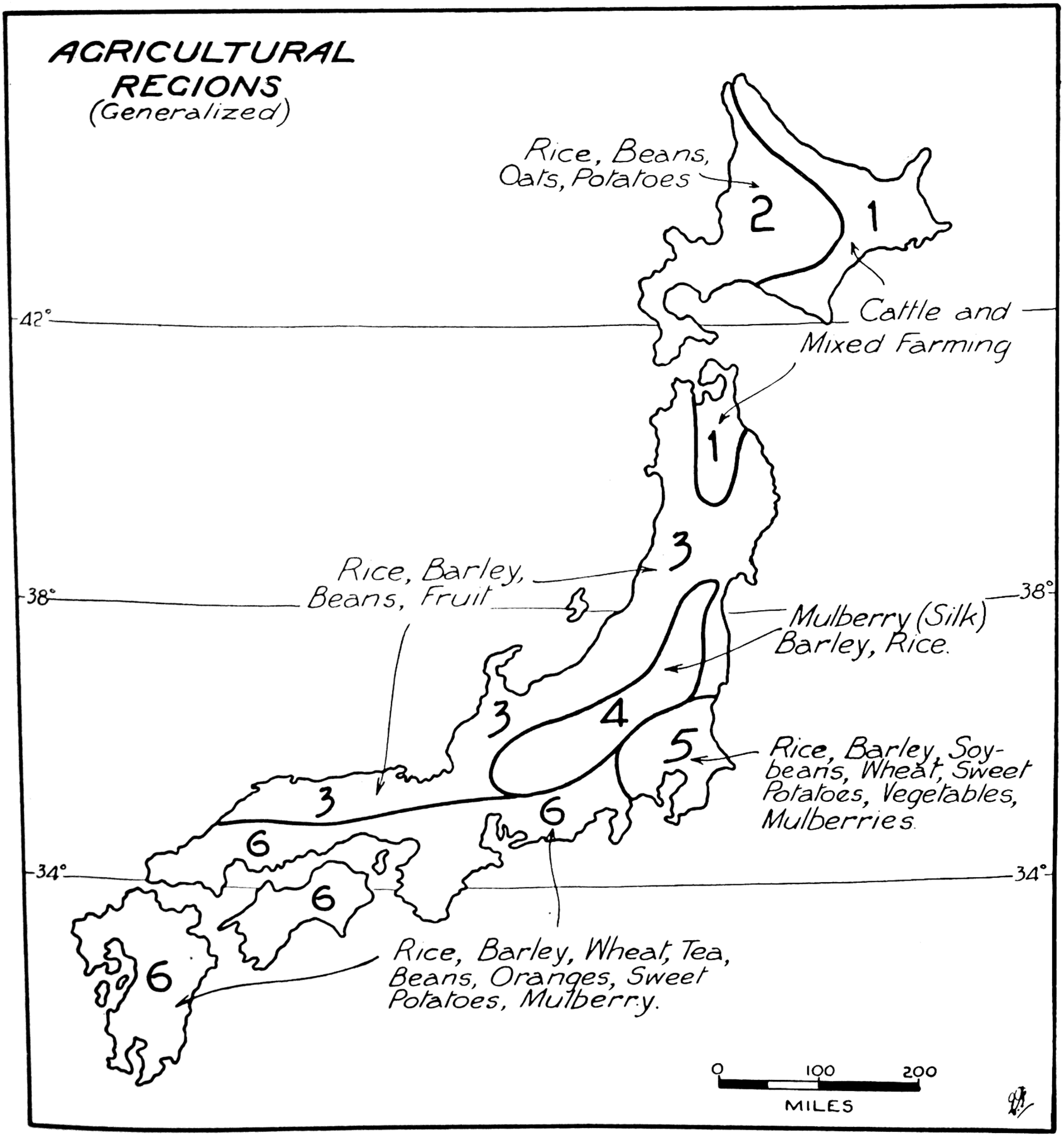

FIG. 50. Agricultural regions of Japan.

hampers proper crop rotation. The dominant position which rice occupies in the agricultural system results from a combination of several factors:

(*i*) The arable land is largely alluvial with flat and poorly drained soils. These are eminently suitable for rice but are not very favourable to ordinary upland and cereal crops.

(*ii*) The yields of rice are high (over 40 bushels per acre) and this is important in providing food for the overpopulated country.

(*iii*) The considerable demand for hand labour in growing the crop is supplied by the dense population.

(*iv*) Rice stores well, a fact which is important in the hot and humid southern areas.

(*v*) The Japanese like rice.

(*c*) Terracing is common on the lower slopes. The Japanese recognize two types of terraced fields: those for irrigated rice and those for "dry" crops such as vegetables, grains, fruits and tea.

(*d*) Multiple cropping is almost universally practised. In some instances in the warmer south, two rice crops are grown in succession on the fields; but in most areas the major crop of rice is followed by cereals, legumes or vegetables. In the poorly-drained areas it is necessary to ridge the fields into parallel raised plots to enable the rotational crop to be grown after the rice crop.

(*e*) Interculture is also a common practice. This is a kind of simultaneous rotation in which alternate rows of different crops are sown at the same time. Thus, in a field of winter wheat or barley, beans may be planted between the rows of grain in the spring. After the grain has been harvested, other vegetables may be planted in its place. By this dove-tailing the land is made to yield several harvests in one year.

(*f*) Manuring. In order to maintain soil fertility at a level sufficiently high to permit intensive cultivation, abundant manuring is necessary. Animal manures, nightsoil, seaweed, fish refuse and humus are all added in the maximum available quantities. These manures are usually placed in shallow pits with water and allowed to decompose before being carried to the fields and ladled on to the growing plants. It is a manuring of the plant rather than of the ground.

Chemical manures (by-products of coke ovens or chemical industrial plants) and soybean cake (from Manchuria) are being used to-day in increasing quantities, but their expense is a deterrent to their wider use.

(*g*) Figure 50 shows the generalized pattern of agricultural regions in Japan and the crop variation shown in the different areas should be related to the earlier discussion on landforms, climate and soils. The lists of farm products are approximately in order of importance for each sub-region shown. Note, therefore, the wide distribution of rice as an important crop.

(*h*) Fishing (see Figure 51). Fish forms a very important foodstuff in Japan because of certain important geographical circumstances:

(*i*) The location and structure of the islands aid the breeding of many edible fishes, e.g. a wide continental shelf, the meeting of cold and warm currents, and a broken coastline.

(*ii*) The many harbours along the coastline have formed suitable foci for fishing people and shelters for their boats.

(*iii*) The scarcity of domestic animals creates a demand for fish as a substitute for meat foods.

(*iv*) Fish offal is an important agricultural manure.

The graph on Figure 51 shows that the sardine and seaweed (both for food and for use as a manure or for obtaining iodine) are the chief marine products, though most of the common food fishes are caught and used.

Over 20 per cent of Japan's population is engaged in, or dependent on, fishing and some 25 per cent of the world's total catch comes from Japan.

Fish products (mainly canned fish) were a very important export commodity before World War II, being third or fourth on the export list.

The bulk (about 90 per cent) of the fish is caught in coastal waters by small-scale fishermen, and the catch is used directly by the villagers or sold in the large cities. The characteristic coastal village has an agricultural-fishing community, whose homes are strung out in a shoe-string form along the narrow shoreline plain.

Outside Japanese waters there is a very significant whaling industry carried on in the Antarctic.

Japanese Industry. The discussion on Japan as a subsistence farming country would be incomplete and inaccurate without some reference to the development of Japan as a modern industrial and trading nation.

Industry was developed in the latter half of the nineteenth century and its greatest expansion occurred between World Wars I and II. Industrial development was fostered and largely financed by the Government in its efforts to make Japan a great world power and in order to provide goods for sale abroad to help buy raw materials for the factories and foodstuffs for the increasing city populations. With this development went the building up of a large merchant marine and a great growth in oversea trade. Its pattern of growth in this was very similar to that of Britain.

By its late entry into the industrial field and by the adoption of the latest factory methods and machinery

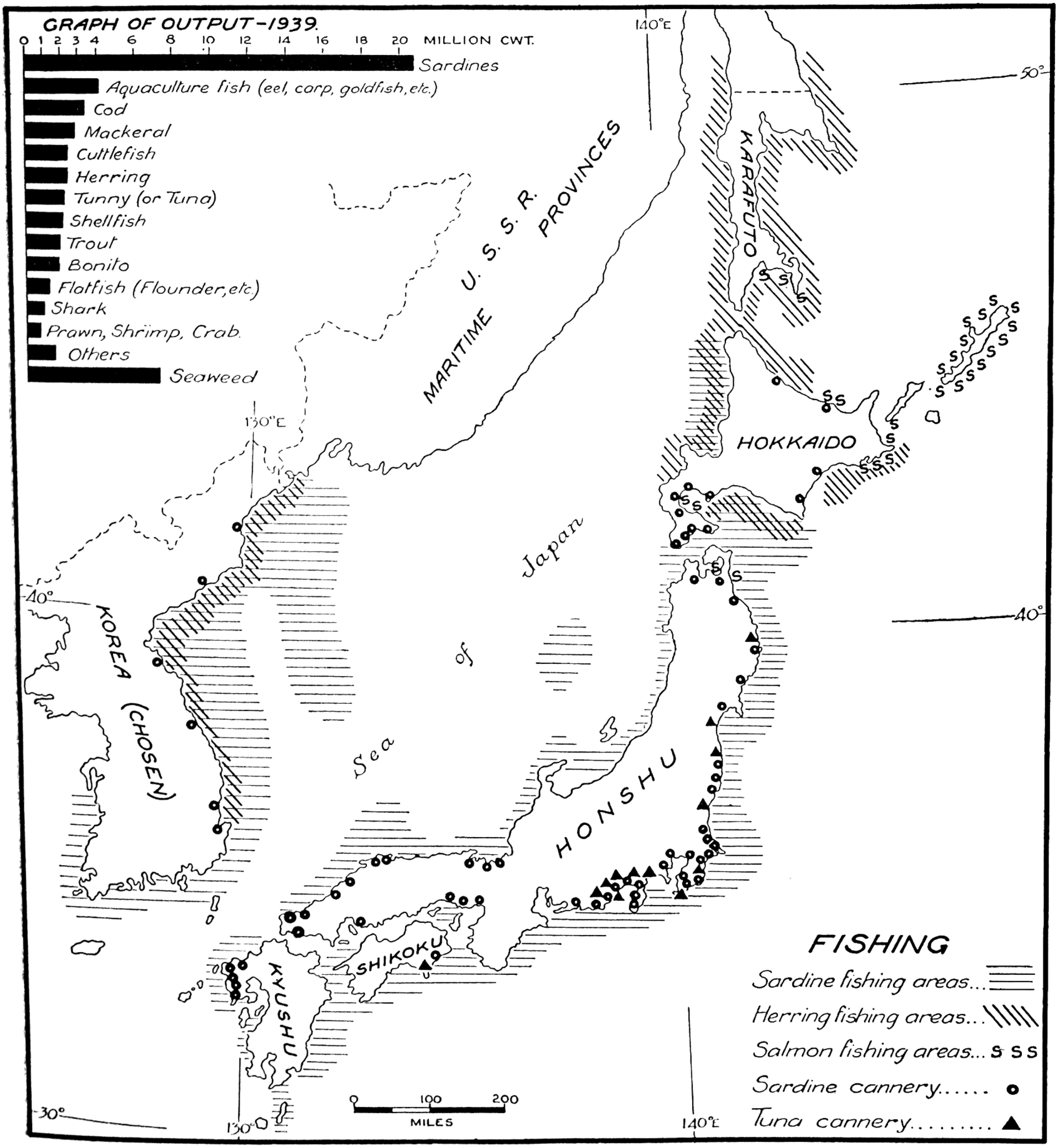

FIG. 51. Fishing in Japanese seas.

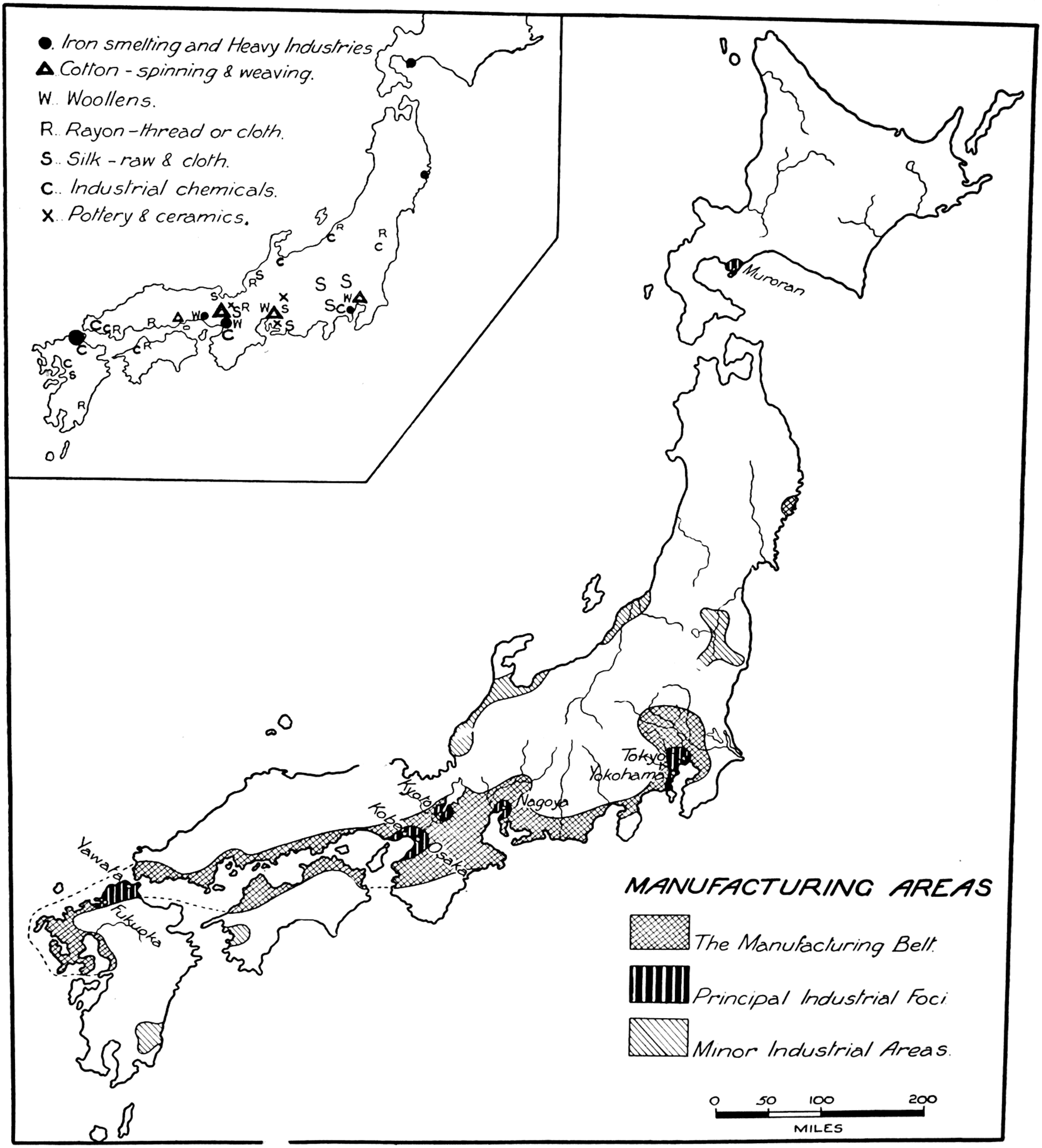

FIG. 52 anufacturing areas and principal manufacturing industries of Japan.

from the U.S.A. and western Europe, Japan quickly ran to the front rank of industrial powers.

At first the industrial structure was unbalanced, with a concentration on the manufacture of textiles, foodstuffs, pottery and trinkets and a very small development of the basic heavy industries of steel, machines and chemicals. This position was partly corrected between 1920 and 1940 and in the latter year the metal industry (principally steel and copper smelting) accounted for 25 per cent of the total value of industrial production, as against only five per cent in 1920. Textiles, on the other hand, had declined from 50 per cent of the total value in 1920 to 18 per cent in 1940. Other products showing relative increases between 1920 and 1940 were: machinery and tools from 11 to 19 per cent and chemicals from 12 to 18 per cent.

A further change occurring in the decade 1930-1940 was in the technical efficiency of the industries. Factory owners installed improved equipment and introduced manufacturing processes which made more efficient use of labour, power and materials. By 1940 Japan had a well-balanced and efficient industrial organization.

Figure 52 shows the general pattern of industrial distribution in Japan. Note particularly that all the main industrial areas occur in a belt stretching from Tokyo to Nagasaki with nodal points at Tokyo, Nagoya, Kyoto, Kobe, Osaka and in northern Kyushu. Reference to the inset map will show the principal industries developed at these nodes and generally throughout the belt. The only important area outside this belt is the steel centre at Muroran in Hokkaido.

Although Japan has abundant supplies of electric power from the many hydro-electric plants throughout the islands and reasonable supplies of good quality coal, she is deficient in most of the raw materials used in her factories. Iron-ore, bauxite, raw cotton, rubber and wool have to be imported together with most of the petroleum. The very foundations of her industrial development rest on uninterrupted supplies of the basic raw materials. Only the pottery, rayon, silk and foodstuffs industries can be supplied from home-produced raw materials. This great weakness was shown very clearly in the latter stages of the Pacific campaign in World War II.

Post-war development of industry will depend primarily on Japan's being able to maintain friendly trade relations with the countries supplying her basic raw materials and on her being able to obtain markets for manufactured goods.

6

COMMERCIAL LIVESTOCK RANCHING IN AMERICA

General Factors. The aim of the commercial farmer is to obtain farm products for sale outside the farming region. The removal of the farm products to markets away from the producing areas necessitates the use of transport. Road, rail and sometimes sea transport are an essential part of the farm economy. In addition, the farmer purchases his general needs of clothing, food and equipment and requires services such as garage maintenance for his machinery and banking facilities for running his business. These develop in villages and towns throughout the farming areas and are part of the farming economy.

Figure 1 on page 2 shows the broad distribution of commercial farming types throughout the world. Throughout the remainder of this book, we shall study examples of each of the main types of commercial land utilization.

Livestock ranching areas of the world. 1. Livestock ranching is a commercial form of land use where the grazier specializes in the selection, breeding and sale of stock (beef cattle, sheep and goats) for a cash return.

2. It is a comparatively recent development in animal husbandry, having its rise mainly in the early industrialization of Europe and America. This led to a demand for increasing amounts of meat, wool, leather, hair, bones and tallow products so that the growth of railways and the later development of refrigeration were responsible for the opening up of extensive grazing lands in the United States, Canada, South America, South Africa, Australia and New Zealand. The more precise areas occupied by the industry in these continents at the present time are shown in Figure 53.

3. Livestock ranching occupies wide areas in temperate and tropical regions. It would be expected that these two broad divisions would show several contrasts in terms of climate, vegetation, types of animals raised and the general organization of the industry. These differences are seen more clearly by reference to the subsequent detailed studies of livestock ranching in the selected regions of North America and Australia.

4. The tropical lands at present are not nearly so important in the livestock industry as the temperate regions. This is because the tropical climates with their high temperatures and heavy, unreliable and

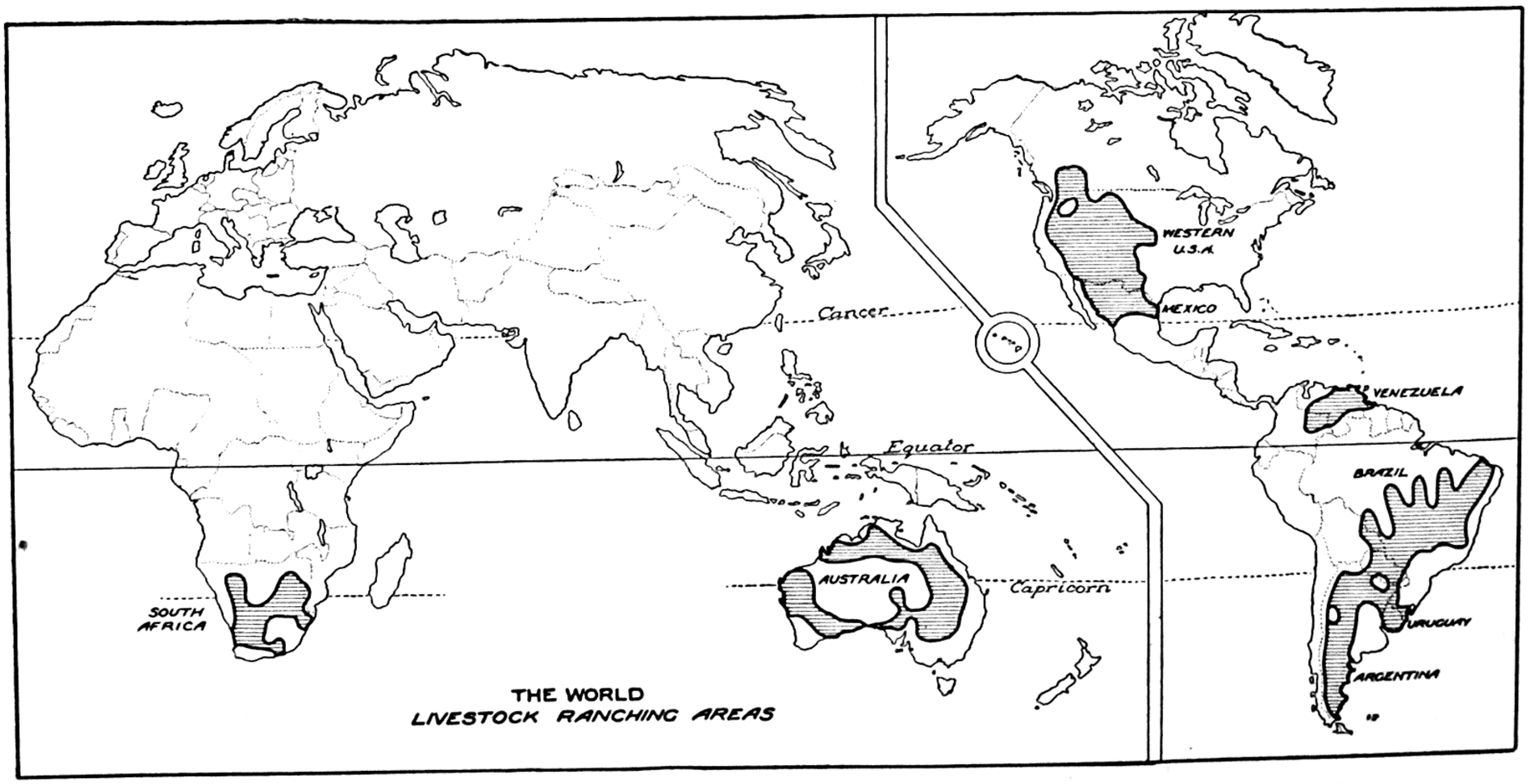

FIG. 53. Major livestock ranching areas of the world.

seasonal rainfall, produce tall rank grasses (savanna), a frequent lack of water for long periods and a number of crippling diseases and pests like the cattle tick. As a result the animals do not make good beef, nor is their general quality improved by native supervision on open lands with no proper control of grazing or breeding.

5. These facts do not mean that the savannas are insignificant in the industry, for they do contribute a reasonable quota of low-grade meat, hides, tallow and fertilizer. Improvement will depend on success in coping with the above disabilities.

6. Commercial grazing in temperate lands has become a highly organized and successful form of pastoral agriculture. For that reason, the following general facts about the industry there are set out. The map may be used as a guide to identify the specific examples given from time to time.

1. Geographic Factors. (*a*) **Landforms.** Livestock ranching occurs on all the varying topographies of the plain, plateaux and mountain lands of the countries named on the map. But the most favoured are the lowland and plateaux areas, for it is there that the main essential of large expanses of open grassland occurs. At the same time the high mountain pastures of many regions are generally used in a seasonal manner: in the summer months the animals are moved to the uplands for a period and then brought back for the colder seasons. This form of "transhumance" is common with the sheep industry of the Rocky Mountains and the beef cattle on the Monaro and Gippsland areas of south-east Australia.

(*b*) **Climate.** All the major livestock ranching areas are situated in regions with a continental climate characterized by hot summers and cool to cold winters according to latitude. For the most part they are marginal lands between the better watered agricultural regions on the one side and the deserts on the other, as in eastern Australia. The rainfall ranges mostly from 10 to 20 inches per annum and is usually seasonal in character, falling mostly in spring and summer. Because great variations occur in annual totals these lands are subject to frequent droughts resulting in large losses of valuable stock. Severe blizzards in the higher latitudes may also do great damage to flocks and herds.

(*c*) **Vegetation.** Most areas have thousands of square miles of undulating grasslands in which the plants are short and tussocky. There are few if any trees in the landscape except along the watercourses. Variations occur in the drier parts, which have steppe features and shrublands like sage and saltbush. Towards the hotter and wetter tropical savannas, tall open grasslands with woodlands appear.

2. Animals raised. (*a*) **Sheep.** In the drier parts sheep for wool and some cattle are bred. The sheep predominate because their grazing is a frontier occupation and they can thrive where cattle might well die. It is for this reason, then, that the sheep industry generally appears as one of the pioneer activities in newly-opened lands. But as the country develops it is replaced in the better areas by more profitable forms of land use. It then moves to the drier marginal lands, where it occupies first place among farming activities in well-developed countries. An excellent example of this form of sequent occupance is seen in the history of the sheep industry in Australia or the United States.

(*b*) **Cattle.** Cattle for beef, while sharing the marginal lands with sheep, are usually raised as a major industry in the better-watered lands. In Australia and the United States they are often associated with various forms of crop farming. The drier marginal lands are frequently a reservoir of store cattle for better grazing areas where they can be fattened. For example, from northern Australia store stock are moved into the beef cattle areas of the east coast (see Figure 61). In the United States they go from the High Plains to the Corn Belt of the Middle West.

(*c*) **Goats.** Goats are like sheep in the way in which they are adapted to the rugged dry areas where pastures are scant. They are widely distributed throughout the world, being important as producers of milk and skins for subsistence and peasant farmers. But as a commercial proposition it is only in recent years, with the rise in the mohair industry, that there has been a considerable increase in the scientific breeding of Angora goats in South Africa and in south-western Texas (United States).

3. General features of organization. (*a*) **Size.** The ranches (or stations) associated with the livestock ranching industry may vary from as low as 2,000 acres to as high as 500 square miles as in northern Australia, depending on a number of factors such as transport and the possible crop association. Many are fenced and provided with wells or tanks where stream water is unavailable, while others are known as "open range" country. Some of the smaller types, as in the United States, may provide winter forage by growing fodder crops during the summer periods.

(*b*) **Land use.** Commercial grazing is an extensive form of land use with considerable variation in the acreage needed to support one animal unit as the land varies from the better-watered to the dry marginal areas. Again, the ratio of crop land to the total area is usually very low, the cultivation being mainly for hay crops and with the aid frequently of irrigation. These differences can be seen in the foothills of the Rockies and the western margins of the Corn Belt in the United States.

(*c*) **Population.** Because of the above extensive use of the land, the farm population of livestock ranch-

ing regions is small and scattered, with few towns and cities. At the same time the standard of living can be high, but the presence of amenities does not offset the isolation. In recent years the industry has been marked by a rise in absentee ownership by large companies. The capital of these can employ special staffs with managers, cope with the huge expense involved in maintaining large properties and absorb the periodic losses due to droughts and market changes.

Finally, many interesting comparisons and contrasts can be made between commercial livestock grazing and nomadic herding, as described previously, in terms of regions occupied, animals utilized, the mode of life followed by the people, and the possible future developments of both occupational activities. But the essential fact is that one is purely subsistence farming and the other is a highly organized commercial function.

Some important factors in North American geography. Figure 54 summarizes some of the important landform and climatic factors which affect land use in North America.

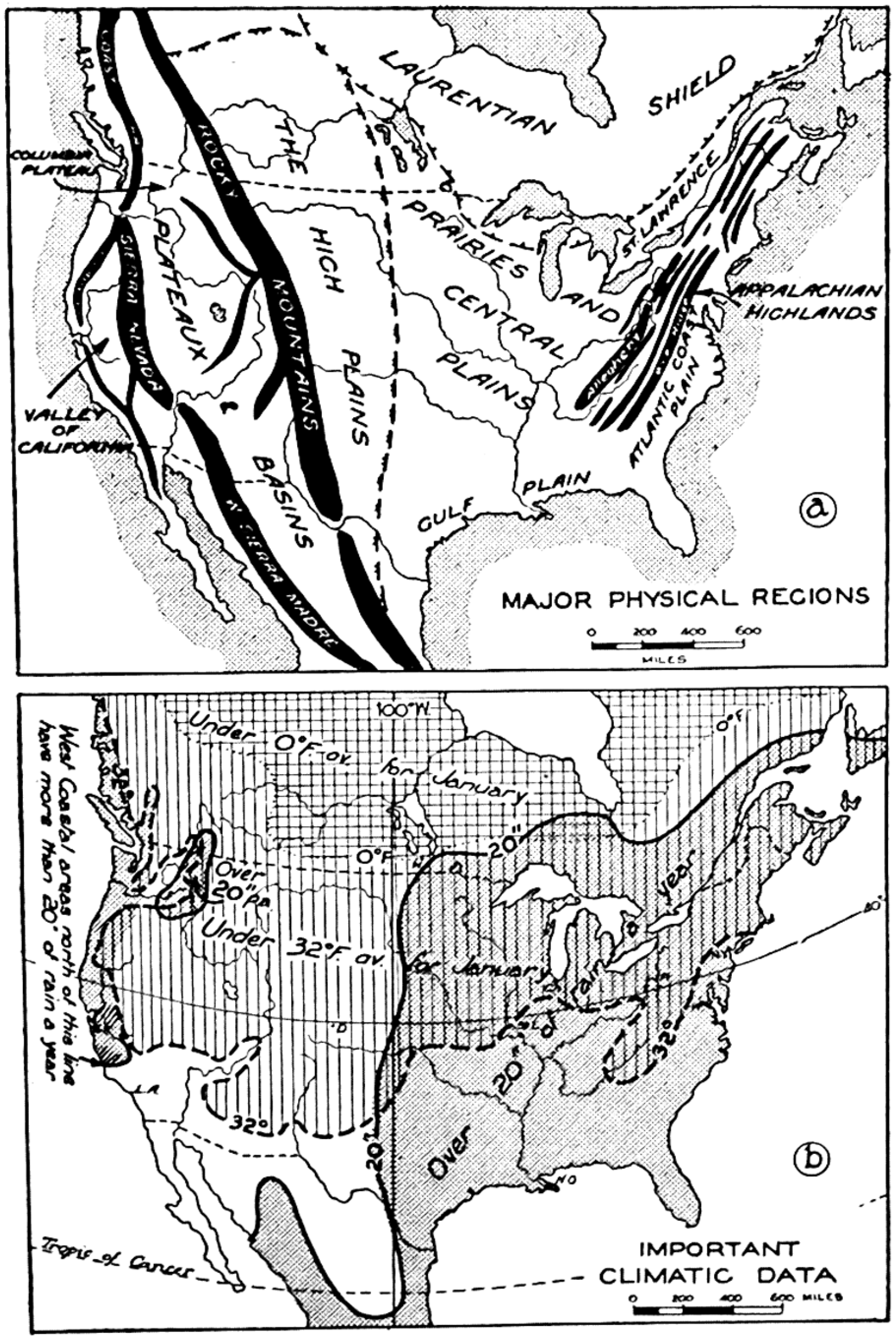

FIG. 54. Some important natural factors in North American geography.

Figure 54a shows that the physical features trend mostly from north to south. In doing this they divide the land roughly into eight parallel belts: (*i*) the Atlantic Coast Plain; (*ii*) the Appalachian system, containing the Allegheny and Blue Ridge Mountains; (*iii*) the great central lowland drained by the Mississippi-Missouri in the United States, and by the Nelson-Saskatchewan and Mackenzie rivers in Canada; (*iv*) the High Plains, which are really a piedmont plateau area fronting the Rockies on the east; (*v*) the Rocky Mountains, which are between 600 and 1,000 miles inland in the United States; (*vi*) the intermontane plateaux and basins between the Rockies and Sierra Nevadas; (*vii*) the west coastal valley plains, of which the Valley of California is the best known; and (*viii*) the west coast ranges.

The position and direction of these landforms greatly affect the climate and the occupational development of the land.

Figure 54b shows that the open central plains allow an uninterrupted southward flow of cold polar air over the country in winter. This accounts for the big southward dip in the 32°F. isotherm during this period. It also means that stock farmers north of this line must make provision for hand-feeding their animals during the winter.

This lowland allows an inflow of warm rain-bearing winds from the Gulf of Mexico in the summer period. Hence a very large portion of eastern United States receives over 20 inches of rain a year. Notice here particularly the close relation between the 20-inch isohyet and the 100°W. meridian. Since in all middle latitudes (between 30° and 45°) 20 inches of rain mark the boundary between safe agriculture and grazing, the 100°W. meridian line becomes a very significant reference line in American geography.

Livestock farming in North America. Since livestock farming is an important industry in North America and because it has significant geographical and economic links with other forms of farming and secondary industry, it is worth noting first of all the over-all pattern of animal husbandry in the continent, generalized in Figure 55. In order to do that a certain geographic background is necessary and that can be obtained by a brief comparative study of Figures 53 to 58.

1. Valley of California. As Figure 54 shows, the Valley lies between the Sierra Nevada and the Coast ranges and is drained by the Sacramento and San Joaquin rivers. Climatic conditions vary throughout, with rainfall such a problem in the south that irrigation there for the production of fruit, vegetables, cotton and alfalfa has become of paramount importance. This accounts for the high carrying capacity of the pastures (see Figure 58) devoted in part to the dairying industry, which supplies the large towns and

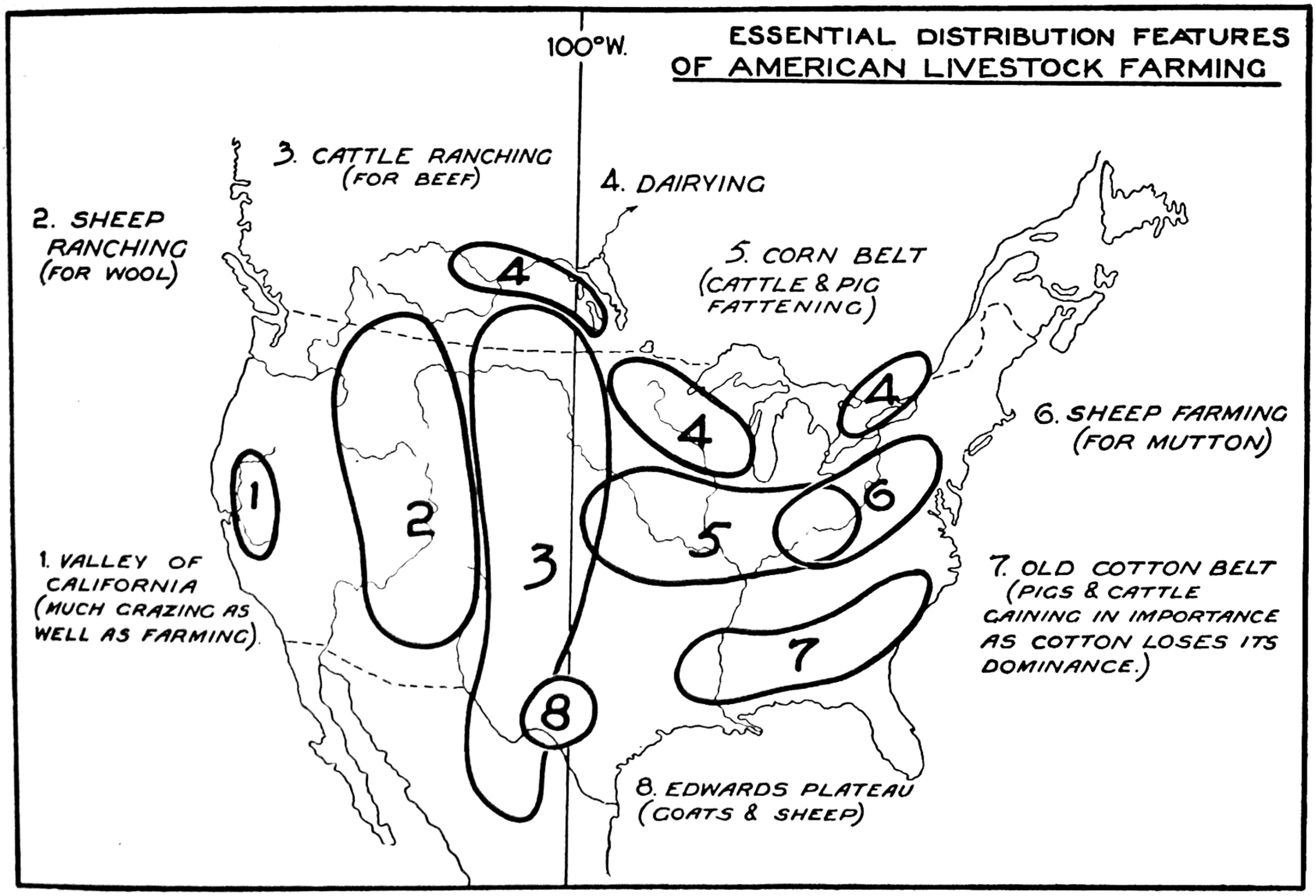

FIG. 55. The essential location features of American livestock farming. This map shows the relationship between the various forms of animal husbandry.

cities. At the same time more than half of the Central Valley and more than two-thirds of the Coast Range country are pasture lands for the maintenance of an important livestock industry. The foothills support beef cattle, while barley, wheat stubble and poorer pastures are used for sheep which supply the fat lamb markets.

2. Sheep raising (for wool). On the plateaux and in the basins of the western mountain lands (with the exception of the Columbia Plateau) such level surfaces as do exist are broken by river canyons and the remnants of block mountains. The barrier of the surrounding ranges contribute to the general dryness of these regions, especially in the south-west. This, together with the altitude and the severe winters, does provide a limited pasturage in the open pine forests and about the timber line where the slopes are gentle enough for stock. Because of these facts it is country which is suitable only for the extensive grazing of sheep for wool, with some beef cattle in the more favourable areas. The industry is often migratory, with the animals being driven to these pastures in summer and returning for winter to the lower levels. Here barley and alfalfa may be grown as supplementary fodders. In the south, on the Colorado Plateau area, the general aridity and the warmth of the winters (note the loop in the 32°F. isotherm here), permit the winter grazing of sheep on the desert margins. The Columbia Plateau to the north, with rich soils in the valleys and basins, over 20 inches of rain in parts and abundant sunshine, has about 13 per cent of its farmlands under hay and wheat crops. Certain areas which are irrigated have a higher carrying capacity than others and these are indicated on Figure 58.

3. Cattle ranching (for beef). This industry is most highly developed in the broad stretches of flat or gently rolling High Plains which rise by a series of great steps to the foothills of the Rocky Mountains. As Figure 54 (*b*) shows, the rainfall is less than 20 inches and the winter temperatures are low. But there are considerable variations within the region with temperatures changing from north to south and rainfall decreasing from east to west. These factors, together

with the use of irrigation from mountain streams and the employment of dry farming techniques, produce marked contrasts in the carrying capacity of the region as indicated in Figure 58. It is possible to classify three widespread types of land use for animal husbandry as follows:

(*a*) The dry grazing areas, where pastures are so poor as to be used much more for sheep than for cattle.

(*b*) The grazing forage areas, where beef cattle can be carried with the aid of forage crops.

(*c*) The farm grazing areas, where large farms produce both grain crops and cattle, using the former for fodder if necessary. Much more detail of the livestock industry (both sheep and cattle) will be seen in the study which follows this.

4. Dairying. A study of Figure 55 will show that dairying extends roughly in a belt from the Saint Lawrence Valley south of the Great Lakes and into adjacent Canada. Within the three major areas shown are many contrasts in topography and soils, but on the whole the geographic factors which determine their particular location, at least in the United States, are heavy summer rains ranging from 22 inches in the west to over 40 inches in the east, glacial soils, cool summer temperatures (the winters are cold), plenty of cheap stored hay crops for winter feed, a close transport network and excellent markets. Over 40 million people live in the dairy belt and half the urban population of the United States is adjacent to it.

Naturally much of it is highly mechanized mixed farming (grain and hay crops, fruit and vegetables) pioneered by immigrant farmers from northern Europe, people with long experience in handling the animals and products (e.g. cheeses) of that type of agriculture. A significant fact is that west of Lake Michigan the emphasis is on dairy products other than fresh milk. Thus Wisconsin and Minnesota are noted for their manufacture of butter, a wide variety of cheeses, powdered and condensed milk and casein. The main reason appears to lie in the high cost of transporting a heavy bulk product like milk to the eastern areas.

On the Canadian Plains dairying has developed to meet local urban demands, although the geographical conditions are not as favourable as in the dairy belt of the United States.

5. Corn belt (cattle and pig fattening). This region of the central plains and prairies is discussed in detail in Chapter 9. Its rolling topography, rich loam soils and warm humid summers make it the largest corn-growing area in the world. A highly developed mixed farming revolves round the corn grown, there being ideal conditions for the production of oats, wheat, alfalfa, hay, fruit, vegetables and poultry. The main grain is used for the fattening of pigs and cattle from the range lands to the west. The corn belt has an interesting geographical location with respect to the other livestock areas.

(*a*) The dairy belt just described bounds it on the north and north-east because of poorer soils, too short a growing season for the maturing of corn, and a proximity to the markets of the industrial areas.

(*b*) Mutton sheep farming forms part of the eastern limit to the corn belt because of the presence of steep, hilly country and poor sandy soils. There is some overlap as shown on Figure 55.

(*c*) Beef cattle ranching, with its drier climatic conditions, bounds the belt to the west. As the map shows, there is again some overlap.

(*d*) The old cotton belt forms an interesting southern boundary, but corn is grown there with almost the same acreage as cotton in places. It is fed to livestock and draught animals or is consumed by the farmers.

With these immediate livestock relations on all sides to the corn belt it is easier to appreciate the geographical significance of the high pasture-carrying capacity as shown in Figure 58 as well as the fact that the region is not a single crop one but a corn-grain-hay-livestock one.

6. Sheep farming (for mutton). Sheep thrive in the areas shown merging into the low dissected Allegheny Plateau. This is because the types of soils and the rugged topography, with steep slopes, discourage widespread arable agriculture. Yet the rainfall of over 30 inches and the milder winters with light snowfalls favour the growth of good pastures (Figure 57). As a result dual purpose animals can be raised, e.g. lambs for meat and various breeds for wool.

7. The old cotton belt. The intensity of cotton-growing in this region in earlier times was favoured by the broad, flat areas of the Atlantic—Gulf Coast Plain (Figure 54) with its soils, mainly rich silts, e.g. the Mississippi Bottom Lands, a rainfall ranging from 20 inches (west) to 60 inches (east) and a long warm frost-free growing period of 6½ months. Added to these factors were others of cheap black labour and good markets. In recent years the reduced productivity of the soils due to intensive one-crop farming and erosion, the ravages of diseases and pests like the boll weevil, the migration of labour to cities and the loss of the former monopolies, placed the cotton farmers in many areas of the belt in a serious position. The solution was found partly in opening up new lands, even with the assistance of irrigation, and partly in recourse to a re-education of the population to the value of mixed farming. As a result, much of the old cotton belt to-day grows corn, wheat, grain sorghums, legumes, fruit and vegetables. Cotton is still grown along with these crops, but not always as a major crop. The high pasture-carrying capacity of the areas is also

indicative of the fact that the farmlands can support a growing number of livestock, e.g. pigs, dairy cattle and draught animals.

8. Edwards Plateau (goats and sheep). This is a dissected limestone area where poor soils and hot dry climatic conditions produce a scanty vegetation of small trees, shrubs, scattered bushes, and a variety of hardy grasses. It can be described as an arid grazing region where the addition of wells, pumping plants and considerable native labour from nearby Mexico enable ranches to support sheep, cattle and goats. The Edwards Plateau has a special significance in the livestock industry of the United States because it produces the greatest number of wool sheep in the country and over half the goats. The Angora is the most valuable of these, being prized for its fine mohair, used mainly in the upholstery industry. The United States has taken the lead from South Africa in the production of this commodity. Settlement is relatively small and scattered except for a couple of larger towns, e.g. San Antonio, which owe their prosperity in part to the oil wells in this part of Texas.

Distribution of sheep, beef cattle and pigs in North America (Figure 56). Reference to the other maps of the series concerned with livestock farming in North America should help to explain in some detail the patterns of distribution in these particular sketches. The following general points are worth noting here:

1. **Sheep.** Note how sheep on the whole are raised over large areas of the continent and can be said to be almost as numerous as cattle and pigs. There are three main areas indicated:

(*a*) The dry steppe lands, mountains and plateau parts of the western and south-western States, where the large spaces of land available, climate, poorer pastures and distance from markets help to determine the concentration of wool sheep there. About one half of the sheep of the United States alone are raised in the areas shown.

(*b*) The humid corn belt and adjacent pasture and grain regions to the north and south, where about one-quarter of the sheep population is found. Imported lambs from the west and some raised locally are fattened for the meat markets of the big industrial centres.

(*c*) The Valley of California, catering for sheep by pasturing on some irrigated areas and the dry foothills.

The secondary areas illustrate the fact that sheep are versatile in their adaptation to physical requirements. Their limitations are obvious in the cold, rugged areas of the Laurentian Plateau to the north, the extreme desert conditions of the south-west and the excessively humid climate of the south-east. On the other hand they can occupy lands which are suitable for wheat, corn and vegetables, crops which produce more in value per acre. So while they are tolerated in the secondary areas, their largest numbers tend to be found on the frontiers of arable agriculture, where there is less competition from crops.

2. **Beef cattle.** Here again the livestock are seen to cover a wide area of North America. A broad division

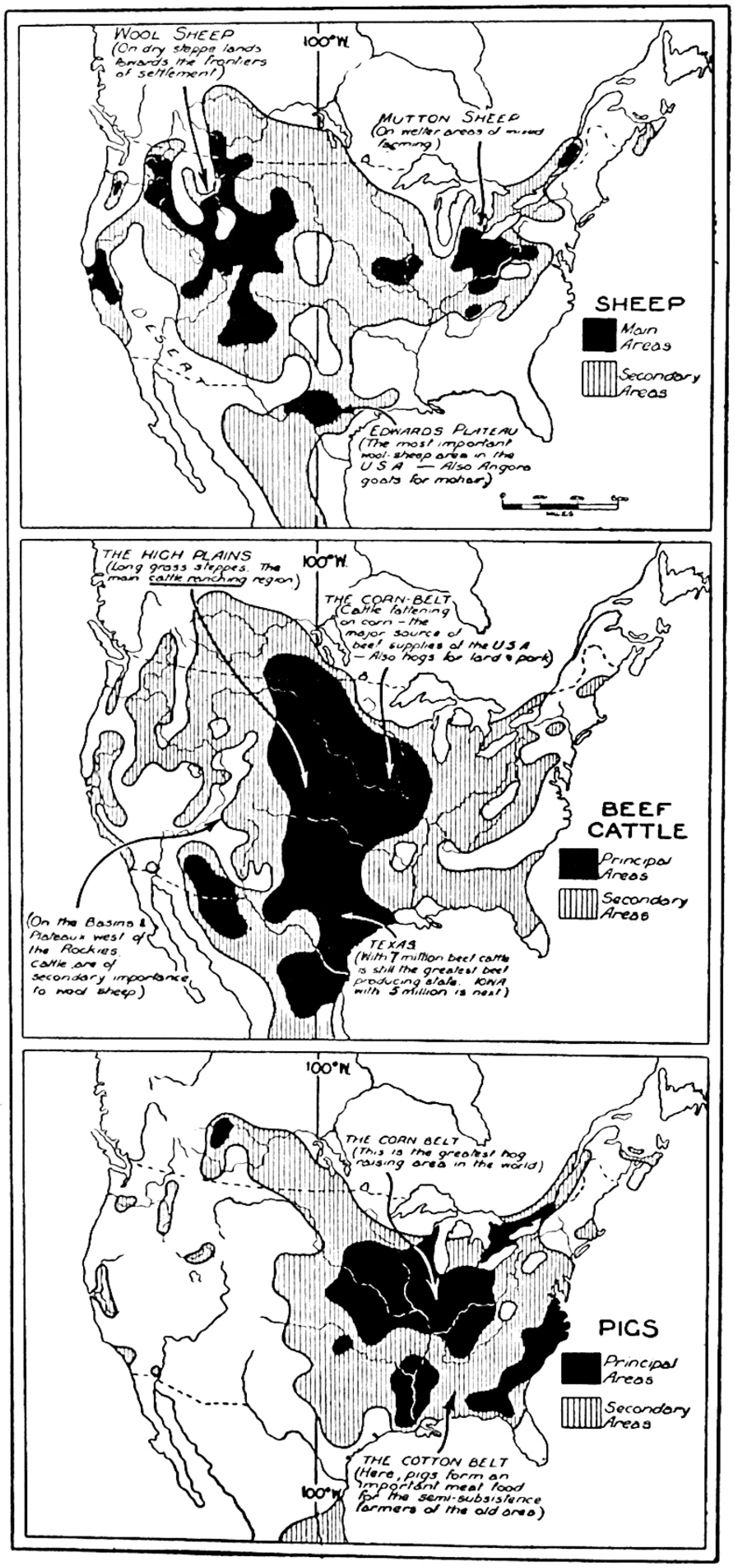

FIG. 56. The distribution of sheep, beef cattle and pigs in North America (*After Department of Agriculture, U.S.A.*).

into principal and secondary beef producing lands may be made and a study of map shows the following:

(*a*) Large numbers on the rolling grasslands of the High Plains of western United States and Canada, with some on the intermontane plateaux of the western cordillera in both countries.

(*b*) A main area on the Texan prairie extending from about Galveston westwards, so that altogether Texas is the largest beef-producing state in the Union.

(*c*) A concentration in the corn belt, where fattening of stock from western sources is an important industry. Considerable numbers of beef animals are bred in the region itself. The main supplies for the United States come from here.

The lesser areas of beef cattle raising occur where other forms of agriculture are more important, but cattle still form a significant part of the general farm economy, e.g. in the dairying and cotton belts. Finally, note those parts where they do not occur because of unfavourable geographical circumstances, as in the regions to the north of the Great Lakes and mountain systems of the east and west.

3. Pigs. These are raised in nearly three-quarters of the farmlands of the United States. In almost all cases the pigs are grown for bacon and lard. These animals are confined almost exclusively to arable agriculture, which accounts for a location in the eastern half of the United States. Within the overall pattern the following are obviously the more important.

(*a*) The corn belt, which is the greatest producer, since there is an abundance of grain. Pigs, as essentially grain-eating animals, consume some 30 per cent of the total maize crop. Greenstuffs are also disposed of when the pigs are permitted to harvest standing corn. The States of Iowa and Missouri are outstanding.

(*b*) The dairy belt, extending into Canada. The skim milk forms an important food, as do various grains grown on small farms for fodder.

(*c*) The cotton belt, where pigs have come to figure in the development of a mixed farming economy. Their ability to scavenge various foods, especially surplus grain, and the improvement in quality in recent years with resistance to fever, have placed pigs in an important place in the meat diet of the small farmers of this region.

(*d*) The Piedmont lands of the east, where pigs are reared with a variety of crops, such as corn, and tobacco.

The secondary areas include those small farms where pigs are fed on most waste products both from the other activities and from the household. Some figure in irrigation schemes along with dairying, as in California. Note the limitations placed by unfavourable landforms and climate, e.g. the mountain lands of the west.

Livestock ranching in western United States. Figure 57 summarizes the geographic background and main features of livestock ranching in western United States as well as the associated occupational activities in that region.

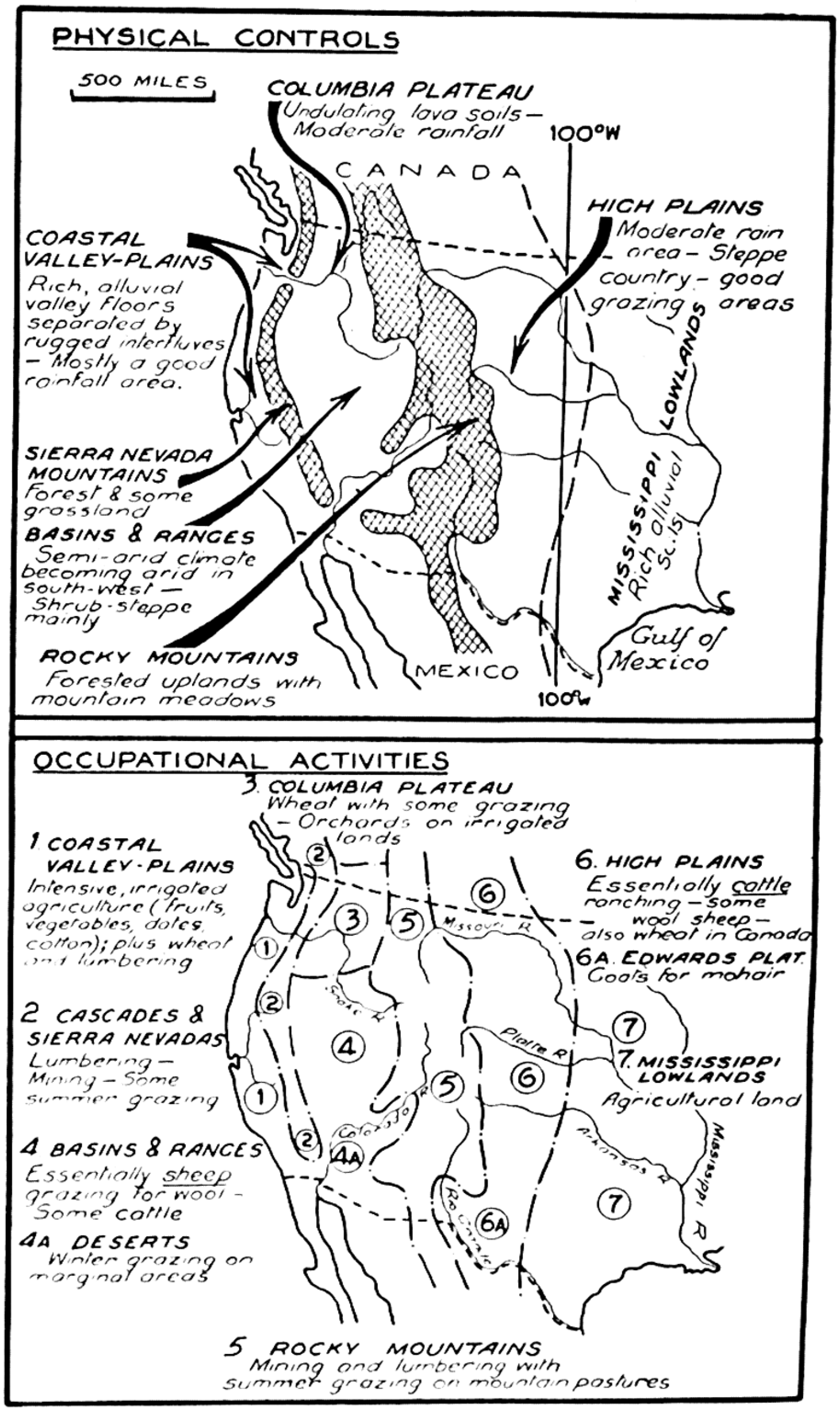

Fig. 57. Map summaries of western United States and Canada to show physical controls and the pattern of occupational activities. Areas numbered 4 and 6 are the principal ranching regions.

1. Location. The main grazing areas lie roughly west of the 100°W. meridian and extend from the Rio Grande in the south to the spring wheat belt in the north. The eastern boundary may fluctuate a little with the variations in rainfall and the price of wheat, e.g., in years of good rainfall and high wheat prices, wheat may occupy some of the eastern fringe, but in drought periods wheat gives way to grazing.

2. Landforms. The High Plains and intermontane basins and ranges are the main areas.

3. Climate (see Figure 54 (b)). (*a*) **Temperatures.** All the areas concerned are affected by altitude. In summer the temperatures generally range between 60°F. and 90°F., but they may go over 100°F. On the other hand the winters are severe, and except for the extreme south and the coastal ranges, the temperatures fall below freezing point over all areas. At this time, too, sudden blizzards may cause damage and loss of livestock.

(*b*) **Rainfall.** Both the Rockies and the Coastal Ranges act as barriers to rain-bearing winds, so that large areas between these mountain uplands tend to have a rainfall of from 10 to 20 inches. On the High Plains the average rises to 20 inches. Most of the rain falls in spring and summer except in parts like the Valley of California and the Columbia basin, where winter rains predominate. There may be wide variations from the above averages, especially on the plains, where over 20 inches may fall for several succeeding years and then be followed by a series of severe droughts. These cycles not only cause hardship to man and beast, but are responsible for accelerating soil erosion begun by overstocking, e.g., the Dust Bowl of 1933-38.

4. Vegetation. Except for the rocky high mountain areas, the dense forests of many of the ranges, and the desert lands of the south, plant life is such as to permit grazing over three-quarters of these western lands. Even in the dry areas of Texas there are edible tussock grasses and shrubs. Among the forest meadows of the mountains short grasses permit summer feeding. On the steppe lands of the High Plains there is the famous grama grass. Within all of these there are variations in stock carrying capacity (see Figure 58), and in the lengths of grazing seasons, e.g., five months in Canada and twelve months in the extreme south. In many parts the grass feed is supplemented by fodders grown mainly in small irrigated areas in the basins or along the foothills. The crops consist mainly of sorghums, millets, alfalfa, clover hay and native grass hays. Although the cultivation for these occupies only five per cent of the land used it is important as a means of providing winter feed to ranchers.

5. Livestock. (*a*) **Sheep.** Sheep raising for wool is the major industry in the drier western pastures. They are less susceptible to disease in dry areas than in wet. They are usually kept in flocks of from 2,000 to 5,000 on fenced ranches and under the care of shepherds. The shepherds generally move with them by waggon when the sheep have to be driven long distances to and from mountain pastures. In the winter months, conditions are arduous for the ranchers. Special feeding has to be done in extreme cold, as well as caring for the new-born lambs before the spring grasses appear. Many of these lambs and older sheep are sent east later to be fattened for market. Wool is the important commodity and these western regions supply 75 per cent of the wool of the United States from such breeds as the Merino (fine wool), Leicester (long wool), and crossbred Corriedales.

(*b*) **Beef cattle.** These are most important on the High Plains, but give way to sheep in the upland and drier areas. They are reared on ranches varying in size from 2,000 to 100,000 acres. The cattle are grazed on open range country or leased mountain pastures in summer and then fed in winter on fodder crops. The main asset of any ranch is water, which is obtained from a variety of sources and piped into tanks, the sizes and distance apart of which will depend on the overall low rainfall of the area or the dryness of the season. When the stock are sufficiently mature they are usually sent to the west coast for meat supplies or sent east to be fattened in the corn belt before being sold there or in eastern markets.

(*c*) **Goats.** These are concentrated mainly on the Edwards Plateau.

Wool, meat, and live animals have a high value per unit of weight and can stand the cost of transportation to markets at great distances. Added to that, this region of sparse population has considerable surpluses of animal products for shipping both east and west to the more densely settled regions.

6. Grazing economy and associated activities. (*a*) The ranches are generally divided into paddocks so as to permit rotational grazing and the proper control of breeding. The buildings consist of the homestead and special farm structures such as large barns for winter shelter and storage of fodder, pens for branding and dipping vats.

(*b*) The differences in climate and vegetation over the whole of the western region are responsible in general for two types of farming practice.

> (*i*) Home ranching using the natural pastures in summer and hand feeding in winter with fodder purchased from irrigated farms or grown on the home farm along river bottom lands. In Texas and New Mexico the milder climate in winter allows for natural pasture grazing all the year round.
>
> (*ii*) Home ranching in winter with some hand feeding and transhumance to mountain pastures in summer. In the south of the region in California, Utah and Arizona some use is made of winter pastures on the desert margins, as the deserts here receive winter rains.

(*c*) Fenced ranges permit selective breeding so that the beef beast of to-day is superior to the stringy type of beast pastured on the open ranges in the early days.

(*d*) Herds of cattle are usually culled in the autumn and surplus young stock and store cattle sold to buyers from the corn belt or sent to farms in the

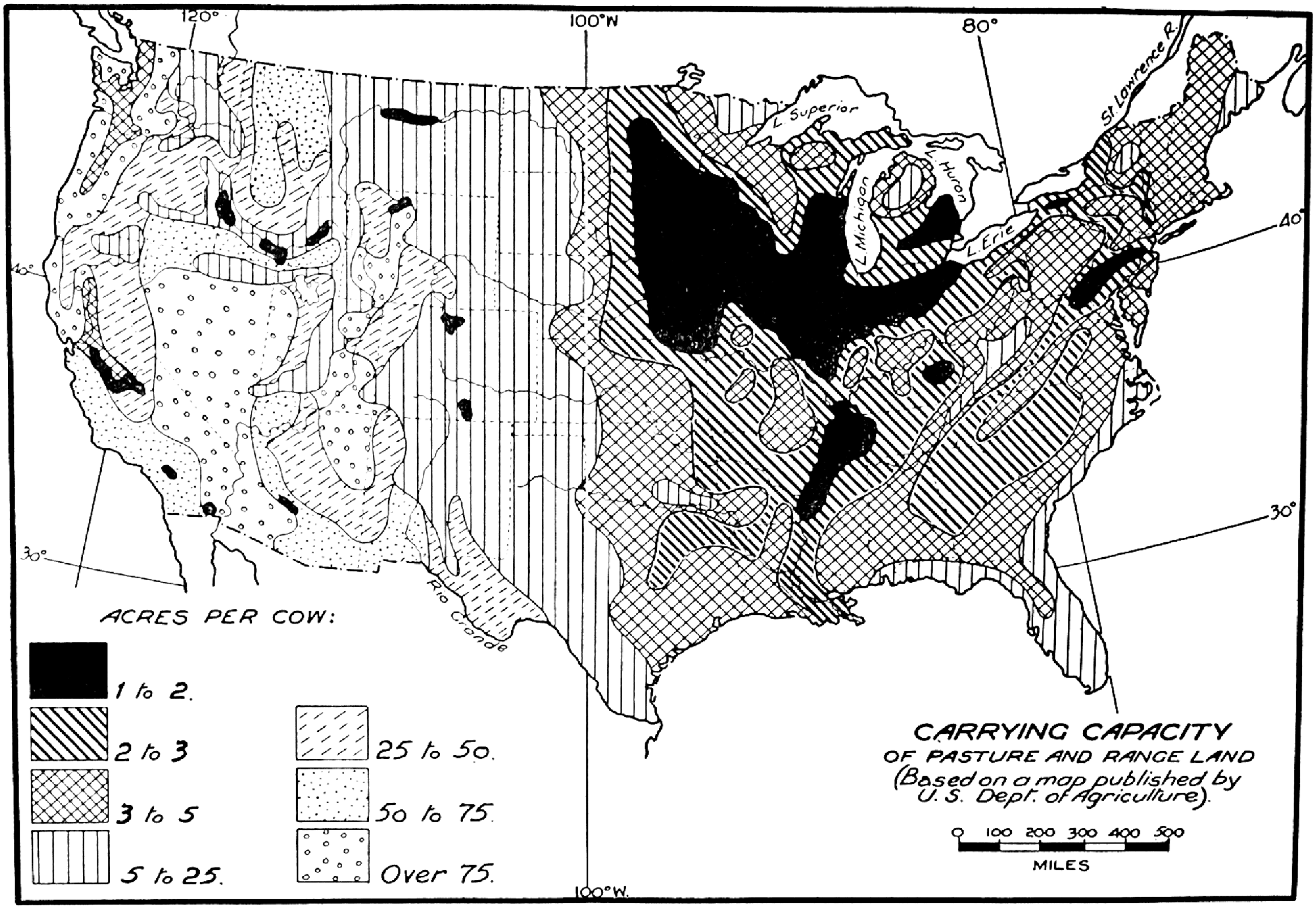

FIG. 58. The carrying capacity of pasture and range land in the United States. This map is closely related to Figure 54 (*After Department of Agriculture, U.S.A.*).

corn belt owned by western breeders. Here they are fattened before passing to the meatworks. Most of the high-grade animals are sent to the markets in the west coast areas.

(*e*) Sheep are shorn in spring and early summer and the wool forwarded to the railhead for shipment to the selling centres and manufacturing cities of New England. Here over 65 per cent of the woollen goods of the United States are manufactured. Surplus lambs and store sheep are disposed of during the summer and autumn. The culling of flocks and herds in autumn is to reduce the number of stock to be hand fed during the winter.

(*f*) Some arable farming is carried on by irrigation within this predominantly livestock grazing area. The schemes are carried out by private companies working on a co-operative basis or by the Federal Government. Some of the best known of the latter are along the Rio Grande and Colorado rivers of the south. Crops raised include not only fodder for stock but sugar beet, vegetables and cotton. The residue of sugar beet is sold to ranchers for feed.

(*g*) The movement of considerable numbers of stock and large amounts of stock products has resulted in the development of scattered towns at trucking and shipping points on the railways that serve the region. They are mostly of moderate size and also serve as the supply centres for food, clothing and farming requisites for the ranchers. They are essentially trading and commercial centres with very little manufacturing beyond the preparation of foodstuffs such as bread, butter (when near irrigation projects), meat packing (in some of the larger centres—see Figure 99), canning of fruits (again near irrigation projects), lumber and timber products (when near forest areas), and some clothing manufactures.

(*h*) The movement of products to the towns and from them to the distant markets requires considerable transport facilities of both roads and railways. The former move farm products out and fodder and house-

hold goods in to the ranch houses with the railheads as the focal points. The rail pattern is one with widely spaced lines as the population density is low and the products from this region are mostly non-perishable as well as having little need for expensive packing. Several famous transcontinental lines pass through the region. An interesting contrast can be made here with the close network of the mid-west of the United States with its intensive farming character. Improved air freight and major road highways are doing much to give better transport services to the west.

(*i*) In many parts overgrazing has resulted in soil erosion by wind on the bare pastures. On the eastern margins of the High Plains the conversion of much natural grazing land to cultivation during the 1920s resulted in wide-spread wind erosion during the dry 1930s. This land is suitable only for grazing and the unwise introduction of dry-farming agriculture created the "Dust Bowl" and gave the United States one of its greatest problems in land reclamation.

(*ii*) In the future, new settlement is likely to occur with the discovery of mineral and oil reserves. Irrigation will also contribute to greater population, but on the whole livestock ranching will continue as the major occupation.

United States and Canada. Population distribution (Figure 59). The geographical significance of the figures shown can only be fully realized by a study of certain important determinants. This has been attempted already in this chapter with some descriptions of the major physical, agricultural and industrial features of the continent. To avoid repetition of many of the facts mentioned before we shall make general observations only. The actual States delineated in both the United States and Canada should be checked with an atlas.

1. Some 58 millions of people are concentrated in the north-east of the continent, embracing the Atlantic Coast plain, a portion of the Appalachian uplands and upper Ohio and that part of the inland along the St Lawrence Basin and Great Lakes. The main

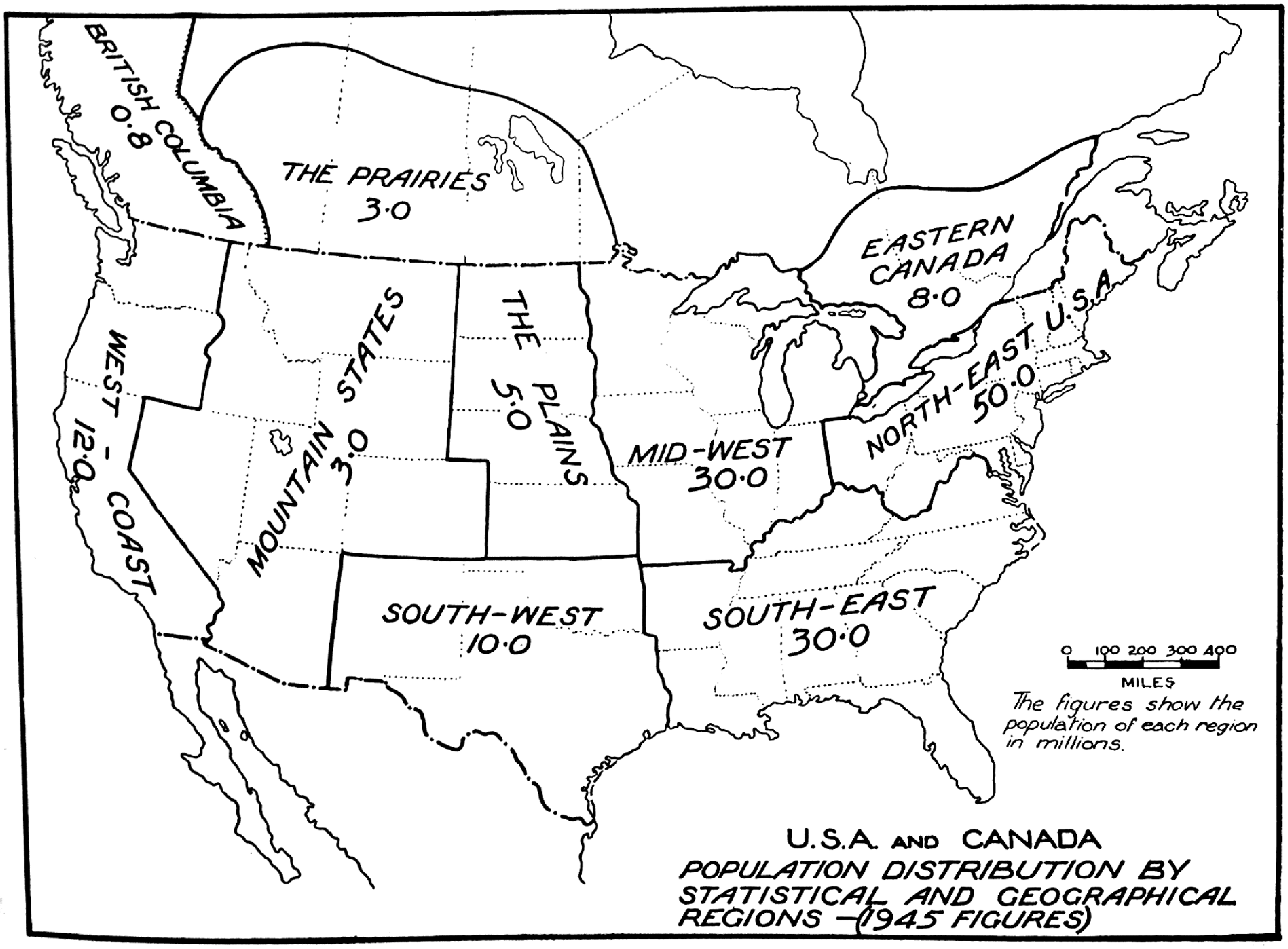

Fig. 59. Population distribution of the United States and Canada.

reasons for such a density of population in these parts are:

(*a*) The historic factor, the early settlement by pioneers who gave certain townships and their immediate environs an initial importance in manufacturing, transport and government. This was especially the case along the coastal plain and river valleys, e.g. Quebec, Montreal, Baltimore, Boston, New York and Philadelphia. As is pointed out in *Regions and Men*, Chapter 4, many of these centres have maintained their importance and grown to large populous cities.

(*b*) Suitability of climatic circumstances to the early settlers of European origin, especially along the St Lawrence Valley, with its mixed farming.

(*c*) The presence of great natural resources to permit the production of food, e.g. dairying and truck farming, and the processing of vital raw materials together with sources of power, e.g. timber, coal and iron ore, as at Pittsburgh, and the hydro-electricity from Niagara and the lower St Lawrence.

(*d*) The presence of excellent lakeside and tide-water ports backed by a rich hinterland and with a location favourable for exports to a growing European market, e.g. Chicago, Buffalo, New York, Baltimore.

(*e*) The development of transport by rail, road and especially water—on the Lakes—to overcome the barrier of the eastern uplands and to serve the growing agricultural and industrial centres linked with ports. On the whole there is a combination of intense industrialization, especially in north-east United States, and agriculture, mining and lumbering.

2. In the mid-west and south-east the 60 million people are largely occupied in agricultural pursuits with large numbers of marketing and manufacturing cities adding the urban population. Concerning the distribution in these regions the following remarks may be made:

(*a*) The landform, soils and climatic circumstances favour the large-scale cultivation of wheat, maize and other grains as well as tobacco and livestock. The foodstuffs are processed to meet the great demands of the local and eastern States' peoples.

(*b*) The presence of enormous quantities of raw materials and sources of power, e.g. cotton, iron ore and oil, which stimulate the manufacture of a wide variety of textiles, steel goods and agricultural machinery.

(*c*) The relatively flat nature of much of the country and the presence of navigable rivers and lakes have led to the development of a widespread and intricate pattern of transport. Several of the larger cities owe their origin and continued growth to their strategic location for transport, e.g. Chicago. Then there are the lakeside and coastal ports, which have grown up as transfer or export points, e.g., Cleveland, Toledo, New Orleans.

(*d*) Once again the historic factor of early settlement by energetic and hard-working immigrants must be mentioned. On the whole many of them made excellent farmers because of their European background of agricultural skills and economy.

This central region of the continent is of special interest because of its relationship to agricultural development and associated secondary industries.

3. The figures for the plains, prairies of Canada, and south-west show a marked decline in contrast with the regions of the eastern States. The factors which help to explain this are:

(*a*) The extensive character of much of the agriculture practised tends to "distribute" rather than concentrate population, e.g., livestock ranching on the prairies and plains.

(*b*) The development of cotton and other crops by irrigation in the south-west, together with oil wells and livestock (cattle and goats) gives it a higher figure (10 millions) than the two regions to the north.

(*c*) Some depopulation in recent years can be attributed to the retiring of much agricultural and pastoral land for purposes of rehabilitation, since millions of acres had been badly eroded by frontier crop farming and overgrazing.

4. The mountain States have a sparse population because of the nature of the environment and the resultant types of human occupancy.

(*a*) This is a semi-arid region with much rugged topography. As such it limits development to large-scale ranching.

(*b*) The area is rich in minerals and most urban agglomerations owe their development to mining activities. In many cases these also act as the trading centres for surrounding ranching lands.

(*c*) In the north, on the Columbia Plateau, an important wheat-growing activity results in a greater population density.

5. The west coast shows higher population figures than any of the western States dealt with so far. This results from:

(*a*) Areas of better rainfall in the Valley of California and the Willamette Valley giving rise to orcharding and market-gardening with some cereal crops.

(*b*) The great engineering feats which brought water and power to central and southern California and to the Los Angeles area from the Colorado. These made possible domestic and industrial supplies to rapidly growing cities and gave water for wide-spread irrigation of orchards, market gardens, cotton farms and date groves.

(*c*) The abundance of electric power, especially in the north-west States and at Los Angeles has aided the development of such specialized industries as aircraft manufacture, aluminium refining, plants for the manufacture of atom bombs, and the motion picture industry.

(*d*) Rich oil wells in southern California have resulted in the development of large oil-refining centres there.

(*e*) The northern States and British Columbia have the largest lumbering industry in North America.

(*f*) The coastal streams and estuaries are important salmon fishing areas.

One important feature of this map is to show the location of the main markets for agricultural products. Study of it will show that the main lines of movement for the products of farms will be towards the north-east of the United States and the west coast areas.

LIVESTOCK RANCHING IN AUSTRALIA (SHEEP AND CATTLE STATIONS)

Beef cattle. Figure 60 illustrates the distribution of this important type of pastoral agriculture in Australia. As such it should be compared and contrasted with the map on sheep raising (Figure 65). From this survey it will be seen that beef cattle are much more wide-spread in a marked variety of environments. Thus they are grazed not only along the tropical Gulf lands, the humid coastal plains of the east and on the temperate ranges and tablelands behind both, but in the monsoonal north-west as well as the relatively arid regions of the far west and centre of the continent.

Examination of the map shows:

1. The greatest areas of beef cattle raising are in the north of Australia, the main stations occurring (*a*) in Queensland, on both the coastal and interior plains, where they appear near sheep holdings; and (*b*) in the northern interior grasslands and woodlands of the Northern Territory and Western Australia, e.g. the Barkly Tableland and the Victoria River. Except on the coast, the climate in these regions for most of the year is hot, with a marked summer rainfall of moderate amount. Droughts are common in the

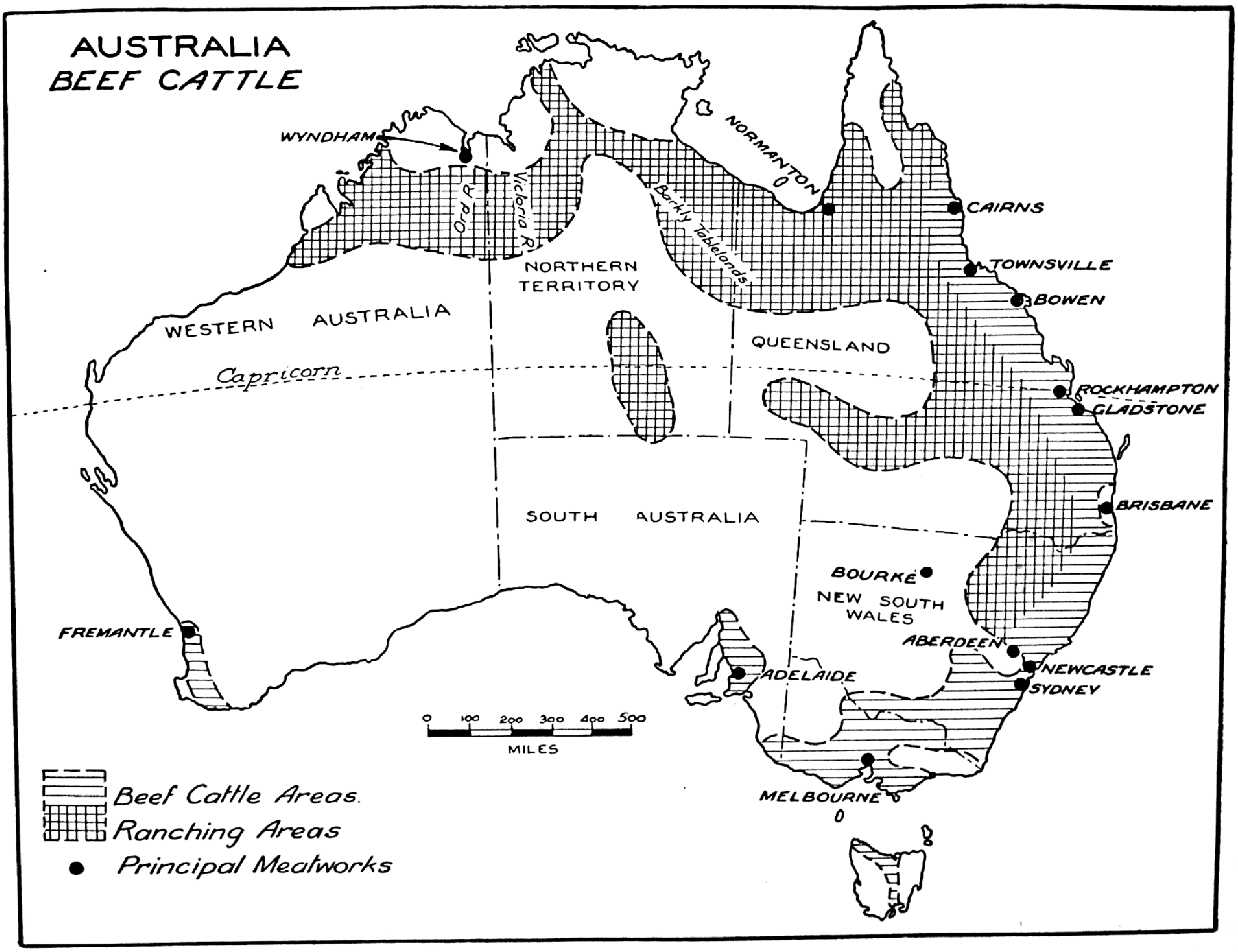

FIG. 60. Beef cattle areas in Australia.

interior but rare near the coast. In this monsoonal climate, the vegetation is mostly savanna woodland with some large areas of almost pure grasslands in the Barkly Tableland, northern central Queensland and the Victoria River and Ord River districts. Owing to the tropical conditions and the winter dry spells, the grasses on the whole tend to be tall as well as coarse in texture. Exceptions are parts of Queensland, where the Mitchell and Flinders grasses form excellent pasturage.

2. There is a distinction made on the map between those areas just described (and including northern New South Wales) which are labelled "ranching" areas, and the beef cattle fattening areas of the Queensland coast and the southern States. This is because the more northern inland parts are generally characterized by a more extensive kind of pastoral activity.

(*a*) As a rule the cattle stations (geographically, ranches) of the Northern Territory and Kimberley district are extensive, often being hundreds of square miles in area, with the stock grazing on native fodder plants, often in timbered country. Properties are unfenced, which in itself prevents proper control of breeding. The low nutritive value of some native grasses and the marked dry season gives a low carrying capacity. These factors and the incidence of diseases and pests, e.g. pleuro-pneumonia, cattle tick and buffalo fly, are very serious handicaps to any endeavour to improve the quality of the meat. Settlement is scattered and each station self-contained once it receives its yearly supplies from such ports as Darwin, Wyndham and Broome. Roads are unknown except for the main arterial ones built during the recent war. Cattle have to be driven long distances to the railhead and then moved to the coast for fattening. These are called "store" cattle. They lose weight and quality during their long transport and have to be built up for sale and slaughter. Even then the meat from them is of too low an export quality to compete in the British market with beef from Argentina. Attempts have been made in recent years to overcome some of these disabilities by: (*i*) the introduction of stock like the Zebu breed to withstand tropical conditions and resist pest infection (the introduction in 1952 of 200 Santa Gertrudis cattle from the King Ranch in Texas is the latest attempt to breed a type of animal suited to the Australian tropical environment); (*ii*) experiments in pasture improvement; (*iii*) the initiation of road, rail and air transport for the handling of stock and freshly killed beef. Some details of the last-named are given below.

(*b*) The beef cattle areas of the southern States are to be found mainly in the mountain and highland areas as well as round the head-waters of such rivers as the Clarence, Hunter and Murrumbidgee. Exceptions are such districts as the lowlands of western Victoria. The animals may be brought from the rougher pastures of the uplands to be fattened along river valleys and better grassed plains. In some cases crop fattening is being increased, e.g., the use of sorghum in northern New South Wales and on Peak Downs and Darling Downs, Queensland. Almost all the beef from these areas is needed to supply local needs, especially of the cities, so that export from the south is virtually nil. Actually, carcase beef and stores have to be brought from the northern stations and meatworks to meet the total needs of the south. Australia consumes about 75 per cent of all beef produced. In addition to the above feature, it should be noted that the southern properties are relatively small and have a high carrying capacity. Most stud breeding is carried on here, using imported English bloodstock which can be moved by fairly short and efficient transport. The raising of beef cattle in the southern States is intensive in character. By contrast, the cattle-grazing (ranching) of the north offers an example of pioneer settlement.

3. The map shows the meatworks as being almost wholly on the coast, where ports assist in direct export. They handle the frozen beef or meat by-products both of stock brought long distances from the interior and then fattened and of the local animals of the coastal hinterlands. The two major works of the north are at Wyndham and Townsville, but the work of these and many of the smaller plants may be reduced somewhat on the one hand by the beef airlift but increased on the other by the road trains. The overall result may well be an increase in the amount of beef now being exported.

Movement of beef cattle. Figures 61 and 62 summarize some of the basic features of cattle-breeding, fattening and movement in northern Australia. The significant factors shown on Figure 61 are:

1. There are three main beef cattle areas in northern Australia:

(*a*) The extensive grazing (ranching) areas of the northern inland. These are primarily breeding regions, though some fat cattle are produced in local areas.

(*b*) The fattening areas of the east coast and highlands, where the better grasses, resulting from the higher and more uniformly distributed rainfall, are used for fattening cattle moved from the interior. Large numbers of beef cattle are bred in these areas, so much so that south-east Queensland and northern New South Wales supply over 80 per cent of the high quality export beef of the Commonwealth.

(*c*) The Channel country, which provides excellent fattening areas in good seasons. This region is formed by the flood plains along the numerous dis-

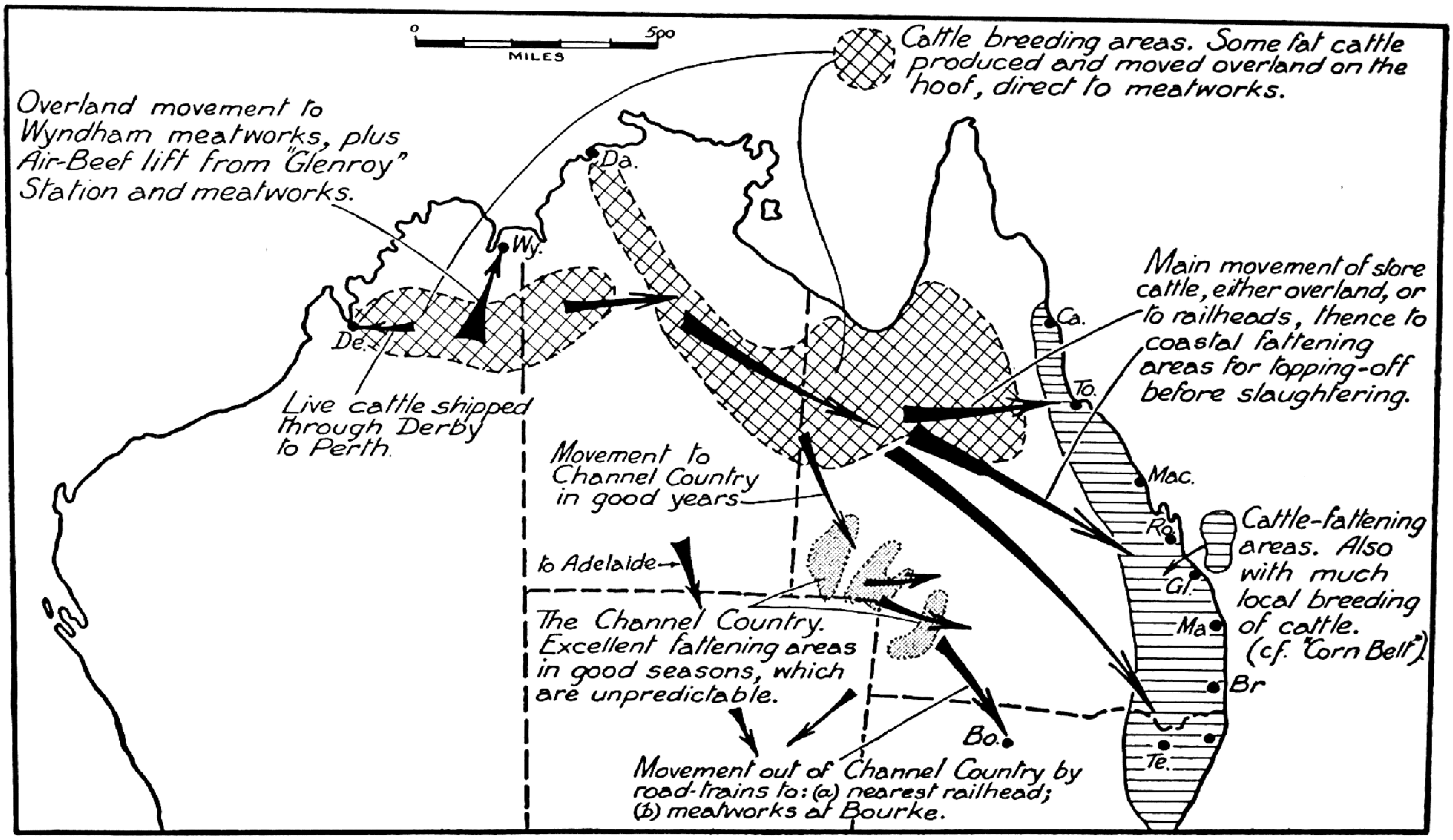

FIG. 61. Basic pattern of beef cattle industry in northern Australia.

tributaries of the inland rivers of Queensland. In high rainfall years (about one year in four or five) these streams flood hundreds of square miles of greyish black-soil plains and a magnificent grass growth results. The main handicap of the area is the lack of good roads or railways to move the fat cattle from the region to the meatworks by road trains or railway trains. The Queensland Government is going ahead with the construction of all-weather roads into this region.

2. The overland movement (illustrated diagrammatically in Figure 62) is principally towards the Queensland coast. At least 80 per cent of cattle moved follow the overland routes towards the Queensland railheads and thence to the coast. It is interesting to see that store cattle are moved from as far as the Victoria River area to coastal Queensland. The movement south to Adelaide is normally only a small one.

Figure 62 further emphasizes some of the salient features of this movement. Note here the loss in weight sustained by cattle moved overland on the hoof. The diagram does not indicate the general toughening of meat fibre resulting from up to seven months of walking in hot climates.

Recent developments. One of the great problems of the beef cattle industry in the north is that of the long transport of stock to the railheads and coastal fattening areas with their adjacent meatworks. Only the better cattle can be moved and these suffer in transit by droving and virtually take a season to regain condition. In an effort to overcome this and so expand meat exports to the United Kingdom, the Commonwealth Government and private companies have been experimenting with some success in two new methods of transport. These are:

1. **Road Trains.** These consist of a fleet of diesel trucks with trailers capable of carrying up to 600 cattle in one lift. They can move stock in a matter of hours over routes which would take weeks of droving, and younger cattle can be marketed even in dry seasons when the usual method is impracticable. Bitumen military roads are being used, e.g., Helen Springs in the Northern Territory to Mt Isa in Queensland. The Government hopes to extend these and improve others so as to minimize bruising, since many routes are still rough and the cattle may suffer much damage in transit. The higher costs involved are generally offset by the greater numbers moved and the improved carcase quality.

2. **Air transport.** This is the air freighting of fresh chilled carcases killed on inland abattoirs to freezing works at railheads or on the coast. Here again is a distinct saving in live weight. In 1951 over two million pounds of carcase meat were flown from Glenroy station (Western Kimberley) 190 miles north to the

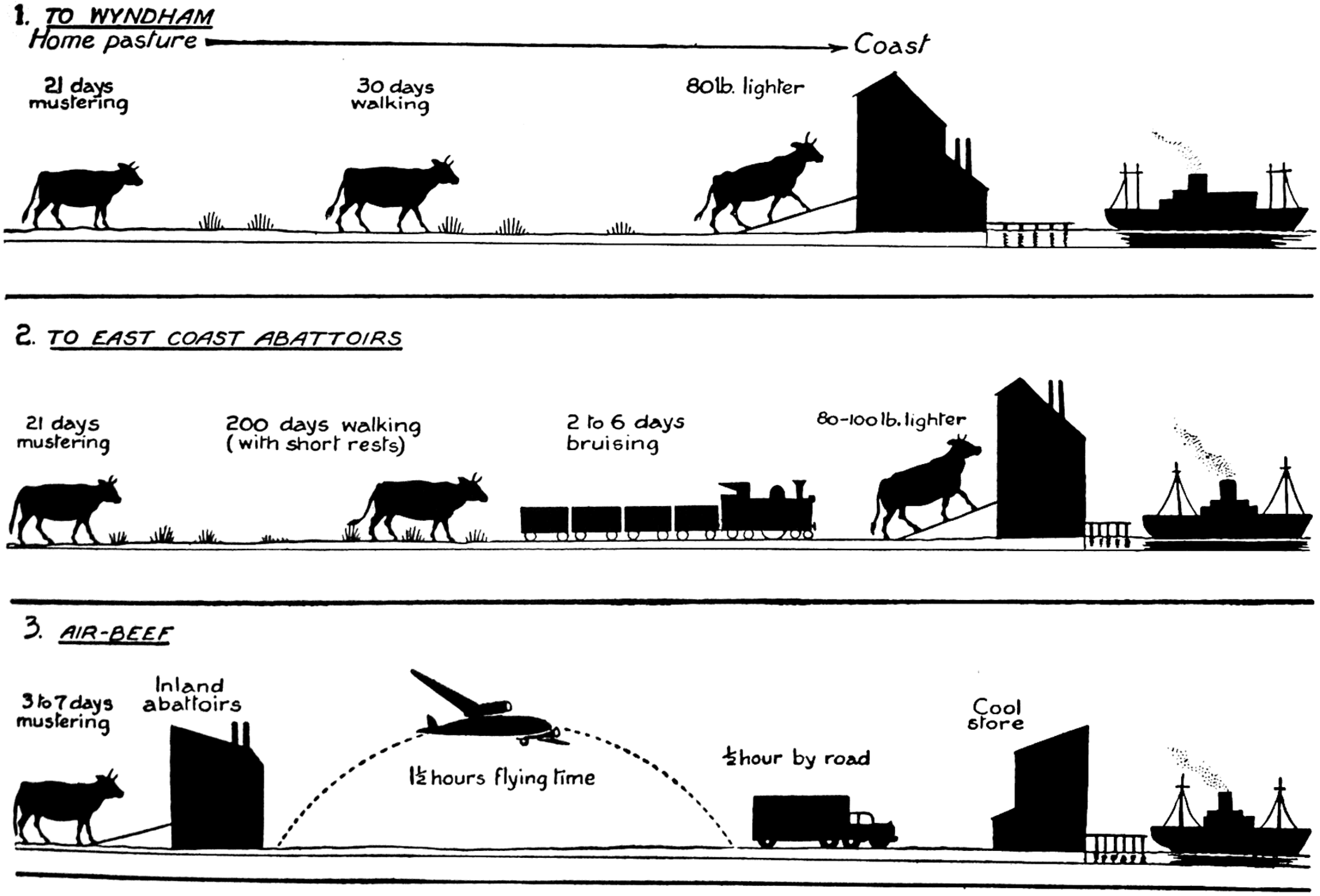

FIG. 62. Diagrammatic summary of the movement of beef cattle and beef in northern Australia.

Wyndham meatworks. The flying time was 1½ hours compared with a full month's droving over a 300-mile route. Air transport has not yet proved an economic proposition because costs are too high and many valuable by-products are being wasted. The problem may be overcome by (*a*) the increasing of backloading of supplies, e.g. general stores, machinery, stud bulls (hitherto difficult); and (*b*) the growth of fodder on river flats for fattening young stock or raising pigs, which could also be fed on cooked offal, to build up pork exports.

Further experiments are still needed in both types of transport. They require heavy capital investment in vehicles, roads, aircraft and chilling facilities. Neither method is likely to supersede the use of railways or droving in the movement of large numbers, but they could become important adjuncts in providing feeder services and making possible the earlier killing of fat cattle.

Future developments. For the future development of the industry in northern Australia, other ideas need to be implemented to make it a paying proposition and to offset environmental handicaps. Suggestions include improvements to pastures to give a higher carrying capacity, the growth of fodder crops along rivers by irrigation, the breaking up of large properties to permit better control of breeding and of pests, and the provision of more dams and tanks. Cost is a big item. Labour is scarce and oversea markets need to be developed. Added to these problems is the lack of amenities and social services, e.g. educational and hospital facilities. The climatic hardships, e.g. droughts, the great distances involved and the loneliness for women and children are deterrents to would-be settlers.

Beef cattle in Queensland. Queensland is the leading beef cattle State with an animal population of about 45 per cent of the Commonwealth total of some 10 million. Figure 63 shows that although cattle are spread throughout almost the whole of the State (and their distribution should be compared with that of sheep), their greatest density is along the eastern coastline, especially in the south-east e.g., Gladstone and Rockhampton. In these particular areas they occupy plain land, but for the rest of the littoral such parts are occupied by sugar-cane, vegetable, and dairy farms. Many of the runs are on the rougher foothills, just below the main ranges, and on the uplands. It is here

that the wetter conditions give more succulent grasses and that some form of pasture improvement is possible. Although many cattle from the western stations are fattened here, most are raised locally and are used for the meat trade. As well as the preparation of older cattle carcases by freezing and the younger ones by chilling, meat is canned, extracts made, and by-products handled, e.g. hides and skins. Some 20 meat-works are engaged in these operations for Australian and oversea trade. The main works are at Brisbane, Gladstone, Rockhampton, Bowen, Townsville and Cairns.

In the western region of Queensland the climatic conditions and vegetation permit only the extensive type of stock raising (Figure 60). In contrast with much of northern Australia the runs (ranches) are smaller.

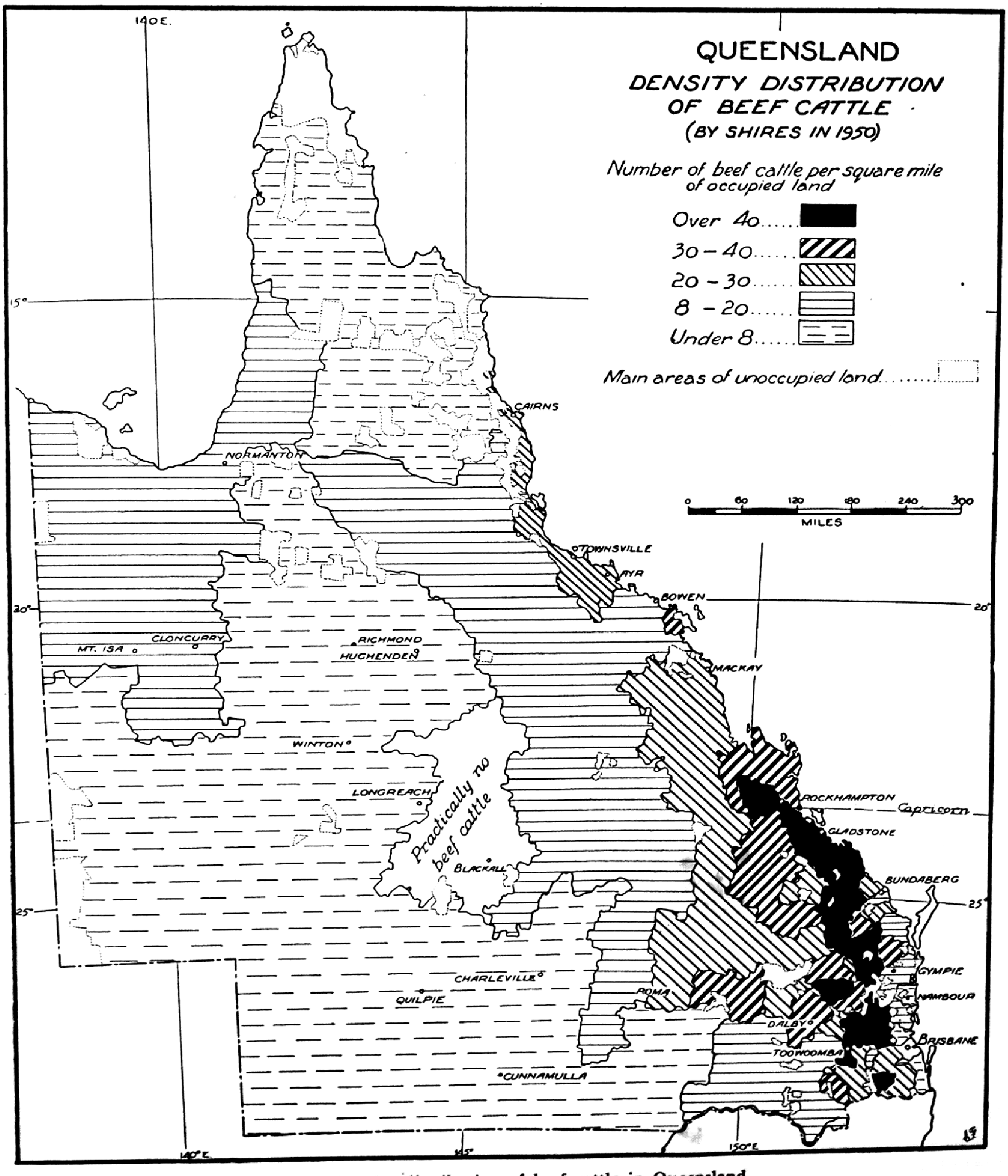

Fig. 63. Density distribution of beef cattle in Queensland.

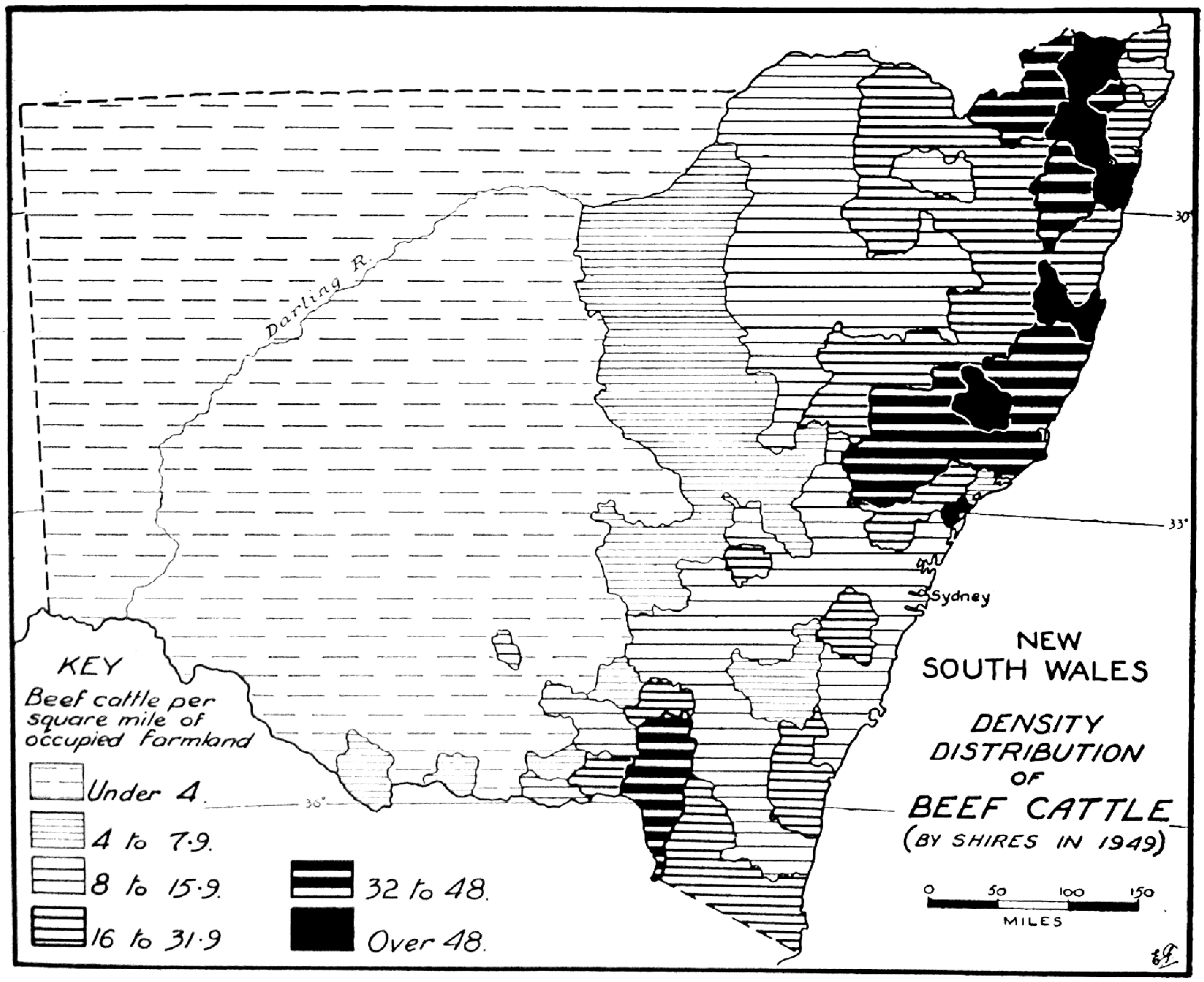

FIG. 64. Density distribution of beef cattle in New South Wales.

Many are fenced. Communications are much better in these areas, which are served by several tentacle feeder rail lines running inland from the ports and meatworks. Charleville and Longreach are examples of such features. Of special interest are:

(*a*) the part played by artesian supplies in watering stock;

(*b*) the movement of store cattle from the north to be fattened in the Channel country about Cooper's Creek alluvial flats, following floods, and their linking up with the coast vie Quilpie, Adelaide and Bourke (see Figure 61);

(*c*) the possibility of flying chilled beef from the stations of the Gulf country to the meatworks at Cairns and Townsville. This might well stimulate the growth of fattening pastures along the Gulf rivers since no planted crops are as yet available and the native grasses as well as losing quality at certain seasons, do not include many legume types.

On the whole, the cattle industry of western Queensland suffers many of the drawbacks already mentioned as affecting northern Australia. Introduced diseases, including pleuro-pneumonia, cause great losses annually. One of the most promising developments of recent years has been the growing of grain sorghum and similar summer crops on the black soils of central Queensland. Used for the fattening of young growing cattle, larger stock numbers and a specially high quality beef could be produced over a longer period. These meats are favoured within Australia itself as "baby beef", and better transport systems would lead to a more effective distribution to nation-wide markets. At the same time, should increased population develop within the State, e.g., following coal-mining developments in the Fitzroy basin, a big demand would come from them. The food would be relatively close to the area of human consumption. Bigger oversea markets would have to be found before export would be effective economically.

Beef cattle in New South Wales. Figure 64 shows the greatest density in:

(*a*) the better watered coastal valleys, especially in the headwaters of streams in the north of the State, e.g., the Clarence, Manning and Hunter;

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(*b*) the tablelands, e.g., New England and Monaro and the south-west slopes, e.g., the upper Murray and Murrumbidgee.

Contrasted with the sheep density (Figure 70), beef cattle graze on pasture lands which not only receive a higher rainfall but are relatively close to the headwaters of inland streams, e.g., the upper Darling.

The low over-all density in the south of the State can be attributed to the more rugged country and the fact that good farming land on the coast is given over to dairying. But the plateau and mountain lands of the extreme south e.g., the Kosciusko area, support many beef cattle by means of a form of transhumance from the foothills to the uplands in order to take advantage of the summer pastures on the snow leases.

The map shows a transition in numbers to the west throughout the sheep and wheat belts because the cattle are not eliminated entirely by the presence of these farm economies and small numbers of beef cattle may be found in association with them, e.g. in the Riverina.

Throughout the State there are numerous stud farms for breeding from imported British stock. In the actual movement of cattle, transport is fairly easy and over shorter distances than in the north of the continent. To overcome crowding of city saleyards and to avoid damage to stock in transit a policy of country killing is now being developed at inland abattoirs, e.g. at Wagga, Tenterfield, Bourke, Aberdeen, Goulburn, Dubbo and Gunnedah. This permits better facilities for the treatment and distribution of meat and meat products in country areas.

Sheep-raising areas (Figure 65). This generalized map aims to show the location of the whole of the Australian sheep belt with some distinction of the major and minor areas within it. A full explanation of it may be gained by reference to the other maps of this series, but there are some features of general interest to be obtained here.

1. The important areas carrying most of the flocks are found in the southern parts of the continent. In these parts the rainfall generally lies between 20 inches and 30 inches a year, and pasture conditions are such as to give a high carrying capacity, i.e. the number of sheep which can be supported per acre.

2. Details of the density distribution of sheep in each State are shown in Figures 69, 70, 71: here it can be recorded that the greatest densities per acre are within the wool-wheat belt, which carries almost one-third of the country's sheep. This excludes central Queensland.

3. The lowest densities are in the less important areas (which actually embrace an enormous acreage) where the rainfall is from 15 inches to less than 10 inches per year and there are marked problems of water supply and pasturage.

4. Within the regions shown there are certain features of the grazing economy which may be mentioned here:

(*a*) Sheep raised for wool only are mainly handled on stations, the equivalent in many ways of the American ranch, but they are usually much larger, since they vary in size from about 3,000 acres in the better areas to over 100,000 acres in the marginal lands.

(*b*) Another sketch (Figure 73) shows how the properties are usually divided up into a series of paddocks with special arrangements for water storage, rotational grazing and pasture conservation. In addition there are buildings other than the homestead which are adapted to the pastoralist's needs in handling his stock.

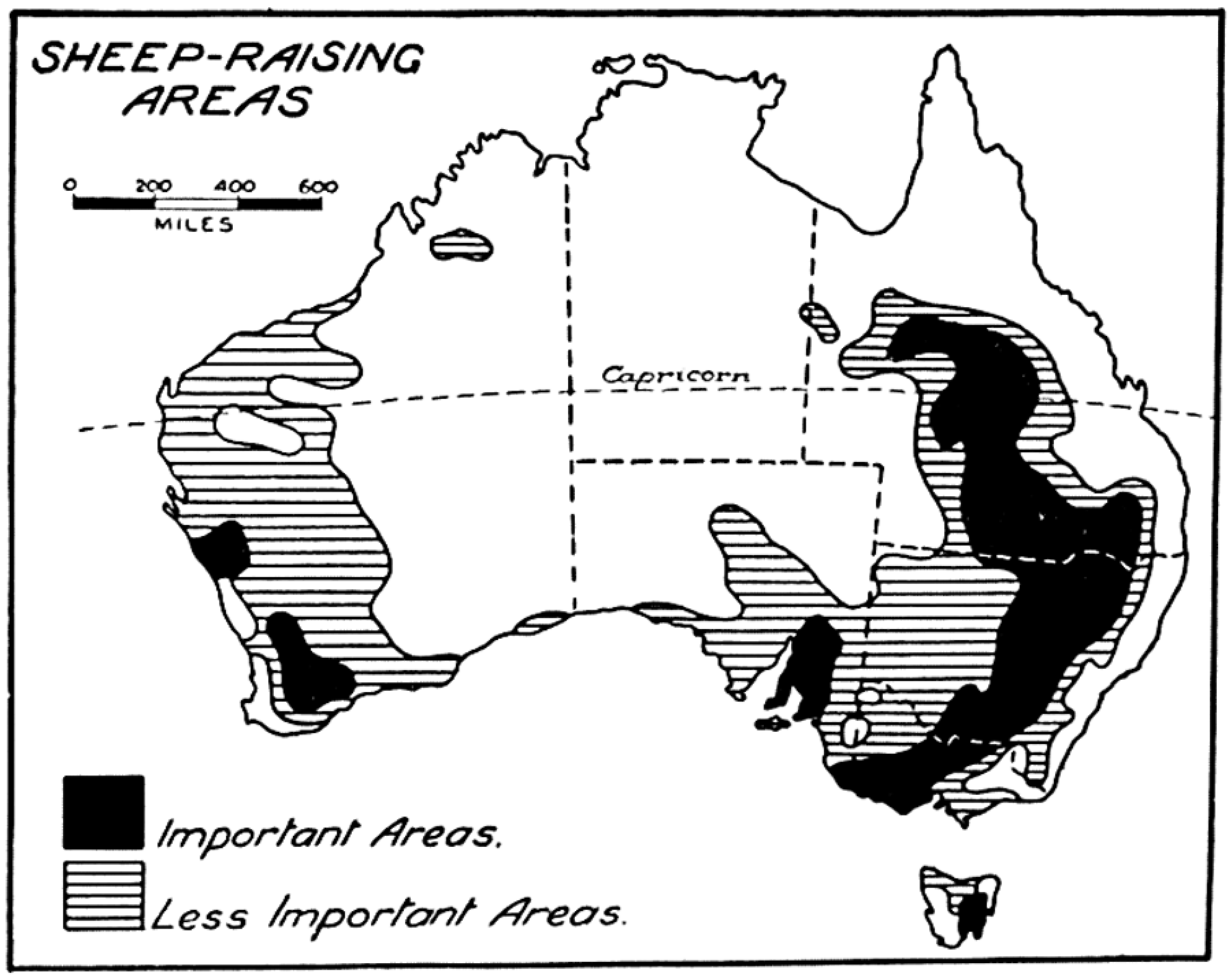

FIG. 65. The general pattern of sheep-raising lands in Australia.

5. There are many human occupational activities associated with the raising of sheep and some of the more important of these are:

(*a*) Transport. (*i*) The carrying of sheep, wool and skins to railways, as well as the movement of animals between stations, has resulted in a network of local roads and main highways to serve truck transport.

(*ii*) The rail lines are tentacles which reach out into the sheep areas terminating at central towns where the yards are equipped with trucking pens, storage sheds, offices, etc., to handle stock and goods.

(*b*) Settlement. (*i*) Homesteads are generally widely scattered except in the wool-wheat belt and the eastern areas.

(*ii*) Larger settlements vary from small townships with the usual store, hotel, school and post office to the larger railhead towns which provide a variety of commercial, manufacturing, transport

and social services. These are well illustrated by Figure 74 showing the township of Mandurama, which gives the plan and service activities of a typical small township.

(*iii*) The population pattern of sheep-farming areas shows relatively low numbers scattered over wide areas.

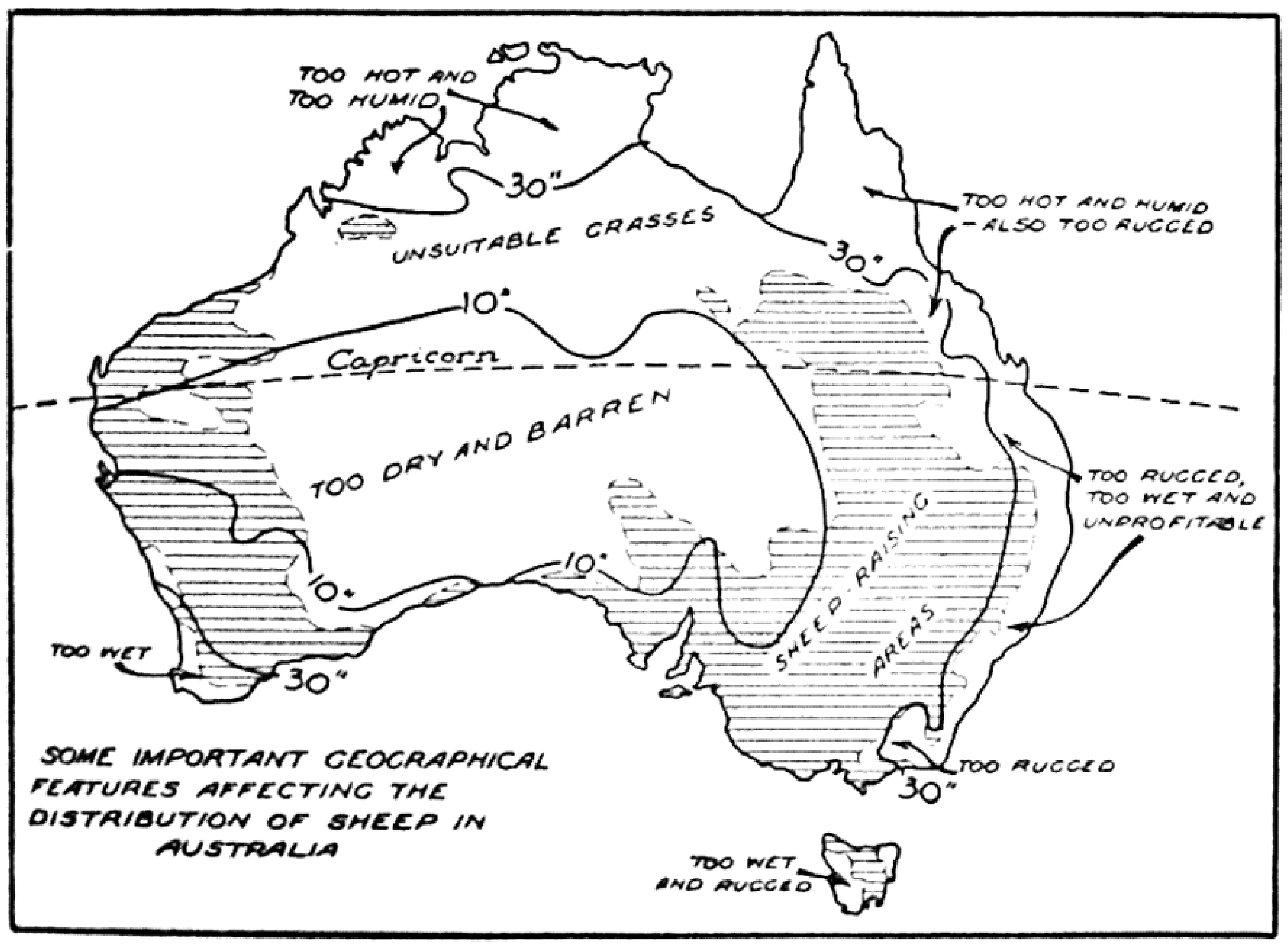

FIG. 66. Some important geographical factors affecting sheep-raising in Australia.

Finally, the distribution of sheep and the associated industries as they occur in Australia might be compared and contrasted with similar features in the United States (see Figures 56 and 57).

The "ranching" phase of sheep-raising in Australia is confined almost wholly to the production of merino wool. It corresponds closely with the area marked "wool producing" on Figure 67, with some examples still persisting in the other areas shown on the map. Discussion in this section will deal particularly with "ranching", but will also include mention of the other kinds of sheep-farming.

In studying Figure 66, attention is drawn both to those factors which are favourable to sheep and to those which limit their distribution. The development and expansion of sheep-raising in Australia have been determined largely by the following.

1. Landforms. (*a*) Sheep are confined mostly to the inland plains of the continent, some of the low ranges adjacent to highlands, such as those in the east, and certain tablelands. Inferior soil types with a poor vegetation cover are common.

(*b*) The more rugged areas of country shown on the map are unsuitable for sheep because they are in regions of high rainfall covered with heavy timber (which makes for costly clearing) and inhabited by such animal pests as dingoes. Such land is more suitable for cattle-raising.

2. Climate. (*a*) This varies considerably, although it can be said that wool sheep on the whole prefer a fairly dry climate to a wet one. As the map shows, almost all the sheep-raising areas lie between the 10-inch and 30-inch isohyets south of the tropics. Seasonal rain falls over the northern areas in summer and over the southern in winter.

(*b*) Water supplies may be affected by frequent droughts, especially in the marginal lands closer to the 10-inch isohyet. This is serious because the consequent lack of succulent pastures may mean an eating out of the remaining vegetation, leading to bad erosion. The sheep have to range too far for water, a task to which they are not as well adapted as beef cattle.

(*c*) In the wetter lands towards the coastal regions, the humidity can be a predisposing factor to the incidence of disease. In recent years more intensive forms of wheat, sheep and fat lamb farming have developed there.

On the coast itself taller grasses and the economic factor of strong competition from dairying and mixed farming militate against the rearing of large numbers of mutton sheep.

(*d*) Tropical Australia is unfavourable for the industry because of heavy summer rains and high humidity.

3. Vegetation. (*a*) This varies considerably nowadays, as will be seen in a later description, but the original vegetation cover was largely savanna woodland with patches of open grassland, often several hundred square miles in area and providing an annual growth. Exceptions were the purely grass downs of central Queensland, the saltbush with few grasses as in the drier interior, and the large patches of mallee woodland to the south.

(*b*) To-day many of the widely spaced trees of both savanna and woodlands have disappeared because of thinning-out operations.

(*c*) The tropical savannas have been and still are unsuitable over most of northern Australia because of their tall, rank growth. Also a big proportion of the centre of the continent with its very low rainfall carries little suitable pasture cover and is barren except for spinifex and mulga.

General distribution of sheep types. Figure 67 is intended to show how sheep types may vary within different sections of the pastoral areas. Their special features are the result of variations in the character of the country, the climate and the pastures. But although there are specialist properties concerned with the raising of each kind of sheep, there is, at the same time, a considerable movement of animals between stations. This takes place with breeding, fattening and marketing as attempts are made to produce better wool and mutton.

Of the types which are shown on the map, the following points are to be noted:

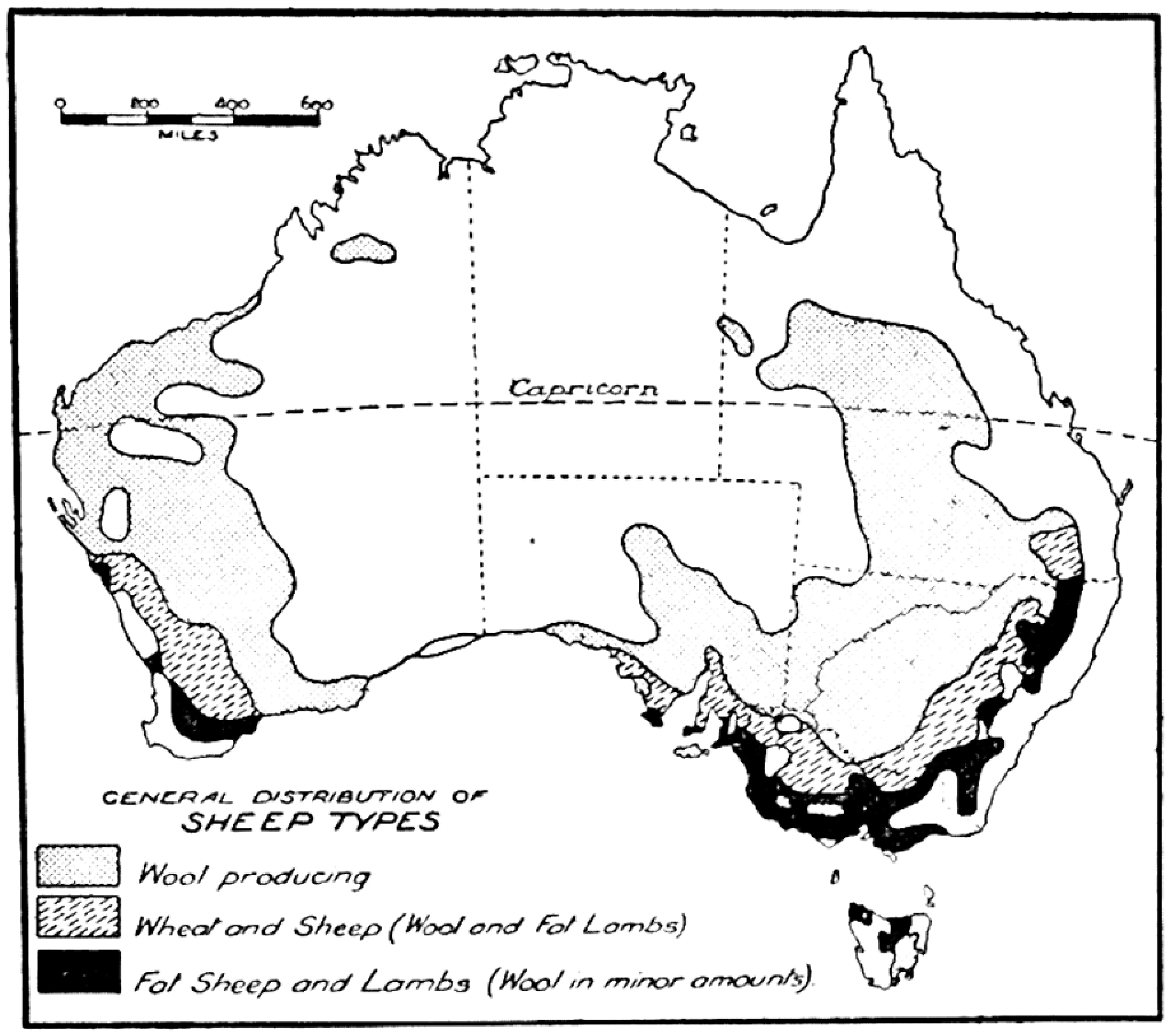

FIG. 67. The general distribution of sheep types in Australia.

1. Wool-producing types. These are largely merinos which make up four-fifths of the flocks of the country. They are regarded as the best wool producers although the spinning quality of the wool varies with the type of merino raised in the particular area.

(*a*) The tablelands with their height, cold climate of comparatively long winters, and sparse pasture, suit a rather small sheep which produces fine and superfine wools.

(*b*) The slopes of undulating fertile country, warmer climate with shorter winters, and more abundant grasses, carry more robust sheep than the tablelands. They produce the medium types of wool.

(*c*) The inland plains with a still hotter climate, good pastures only in favourable seasons, water difficulties and generally tough conditions, must have large strong sheep. These give a long but not so fine wool as the other types.

2. Wheat and sheep (wool and fat lambs). The map shows this type of pastoral activity in such regions as the Darling Downs of Queensland, the western slopes and parts of the tablelands of New South Wales, a large proportion of northern Victoria, the southeast of South Australia (including the Adelaide Hills district) and an inner section of south-west Western Australia. Merinos are bred here for wool, but they are also crossed with English breeds to produce valuable fat lambs. The Corriedale is a dual-purpose breed of sheep producing both medium quality wool and a heavy body for meat. In these regions stud-farming is important, since graziers breed such sheep as well as certain types of merinos for wool only.

Flocks which are run on wheat farms derive their feed from such sources as stubble after harvesting, weed growth on the fallow, pastures on land unsuitable for cultivation, and in some cases on irrigated lands, e.g., Shepparton, Victoria. Such practices form an important part of rotation in land usage in these parts.

3. Fat sheep and lambs (wool in minor amounts). These types of sheep are bred in the wetter areas of the sheep belt, e.g., central and western Victoria and southern New South Wales. They may be pure Corriedale or Polworth; or first cross English long wool types with Merino ewes; or derived from a crossing of cross-bred ewes and Southdown or Dorset Horn rams. Minor amounts of wool of varying qualities are obtained, but the emphasis is on the fattening of sheep and the raising of lambs for local and oversea markets. Most chilled and frozen mutton exported comes from the areas marked on the map.

Fodder within the main sheep areas. Figure 68 needs to be examined in relation to the rest of the series devoted to sheep-raising, since they give some general indications of those pastures and crops grown which can be used for conservation purposes. The practice of fodder conservation is not as common in Australia as in the United States. Apart from certain economic and geographic conditions of soils, climate and labour supply, major determinants here are the absence of severe winters and insufficient extensive irrigation from rivers and mountain lands. On the other hand these factors do not entirely account for the lack of what is recognized by many as good farming practice, especially in view of the recurrent drought seasons in Australian pastoral lands. In the parts devoted to the production of hay crops, the area varies a good deal from year to year because

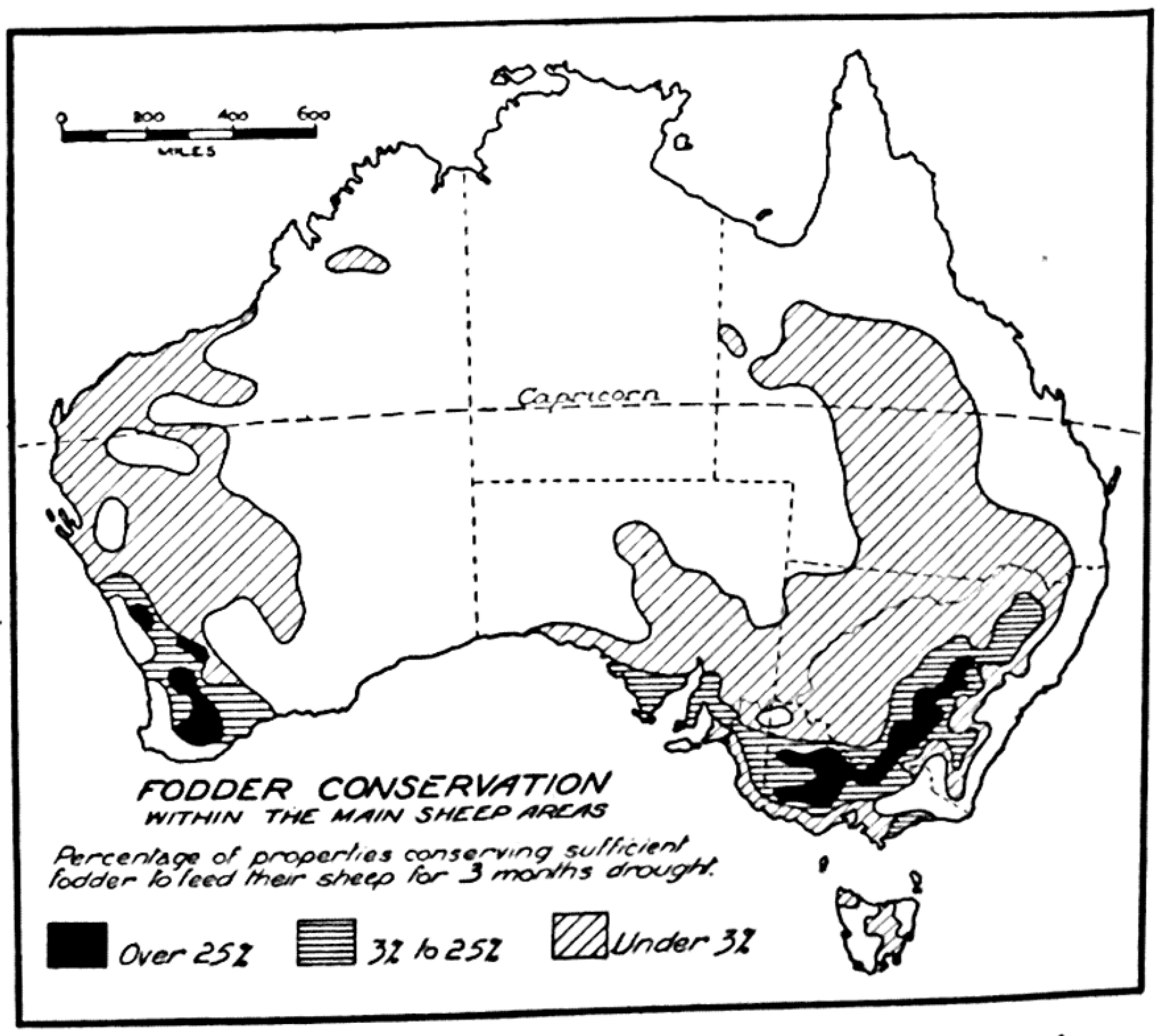

FIG. 68. Generalized pattern of fodder conservation in Australian sheep areas.

of changes in the relative prices of grain and hay and to seasonal conditions which largely affect the allocation of cereal crops between hay and grain production.

Looking at the map itself, these points may be made:

1. The highest percentage of properties conserving sufficient fodder are within the wool-wheat belt, more especially in New South Wales, Victoria and Western Australia. In these the soil and climatic conditions encourage growth of various types of hay crops, the chief of which are oats, wheat and lucerne. Conservation is also associated with a rotation in land usage, which is necessary for better wheat cropping. Food may also be available from stubble, from weeds on fallows, and from peas and lupins, all depending on local circumstances.

2. Although the bulk of the acreage devoted to fodder crops is concentrated within the wool-wheat belt, there is an extension beyond these limits in Victoria and Tasmania. Hay is grown only in a small way in the northern summer rainfall regions, as can be seen by noting the thinning out towards the north of the continent. As a rule the districts shown as ranging from a three per cent to a 25 per cent conservation are those where either rough country or certain soil and moisture deficiencies have affected fodder growth.

3. In areas of low conservation, cultivation is rare and the storage of hay and other fodder reserves infrequent, even following periods of maximum plant growth. Native vegetation is looked upon as the staple food. Repeated droughts lead to the cropping of edible shrubs and the eating down of perennial grasses. The problem of hand feeding is difficult to solve on large properties because of labour costs. Even if helped by additional labour, the station hands could not collect the amount of hay needed to see the flocks through a long dry spell.

The Australian sheep farmer is not fortunate in the matter of natural fodder grasses, for most of the native grasses will not cut and store as hay fodder. The uncleared nature of the sheep country makes the use of mechanical equipment very difficult. This means that the man who wishes to undertake schemes of fodder conservation for his stock must plant exotic grasses or crops and must go to the expense of having all timber and litter cleared from the paddocks. Most farmers do not consider the expense justified except on limited areas of their farms.

Density distribution of sheep in eastern Australia (Figures 69, 70 and 71). The carrying capacity of the various shires and counties in each State varies for a number of reasons, e.g., the nature of the land surface, the seasonal changes of climate, the fodder and water supplies available, and the manner in which the properties are managed. Examples of this can be seen by contrasting the hilly districts of southern New South Wales where relatively small properties having ample water and good natural pastures can support one sheep to the acre, with the far western sections of the State, where large stations having low and uncertain rainfall plus mulga vegetation can carry only one sheep to thirty acres.

The following general points can be made about the sheep density of the three eastern States:

1. Queensland and far western New South Wales. (*a*) Landforms vary from extensive plains to rolling downs with considerable variation in soils and vegetation. Two distinct types of pasturage are evident in the savanna woodland. They are (*i*) the Flinders and Mitchell grasses, products of the heavy soils and the 15-inch to 30-inch rainfall of the downs country; (*ii*) the semi-desert plants with shrubs like mulga and shrubs like saltbush, on lighter soils of the 10-inch rainfall areas of both New South Wales and Queensland. All parts carry an abundance of pasturage after rain, but with bad management there is a danger that it will not only be eaten up rapidly but eaten out completely, thus creating wind erosion problems.

(*b*) Examination of the carrying capacity shows that in the favoured area of the Darling Downs the sheep population is over 160 to the square mile, but in the rest of the State it varies between 20 and 160 to the square mile. The more rugged country to the east, the rainy conditions and poor soils of the north and the poor pastures of the south-west set limits to expansion beyond these carrying capacities. There is some overlap of cattle with sheep in certain areas. This accounts in part for the lower numbers of the latter where it does occur. Around the Darling River country of New South Wales there is considerable marginal land and the carrying capacity of 40 to 70 to the square mile is regarded as the safe limit. Beyond that, the maintenance of water supplies and natural herbage is difficult.

(*c*) The management of the stations in both States is regarded as efficient, e.g. the manner in which the flocks are controlled in the grazing of pastures, although there has been some criticism of the lack of cultivation and conservation of fodder in the good seasons. Quoting American examples here would not be sound because of the different climatic conditions and the greater possibilities of irrigation on alluvial fans from the mountain waters in western United States.

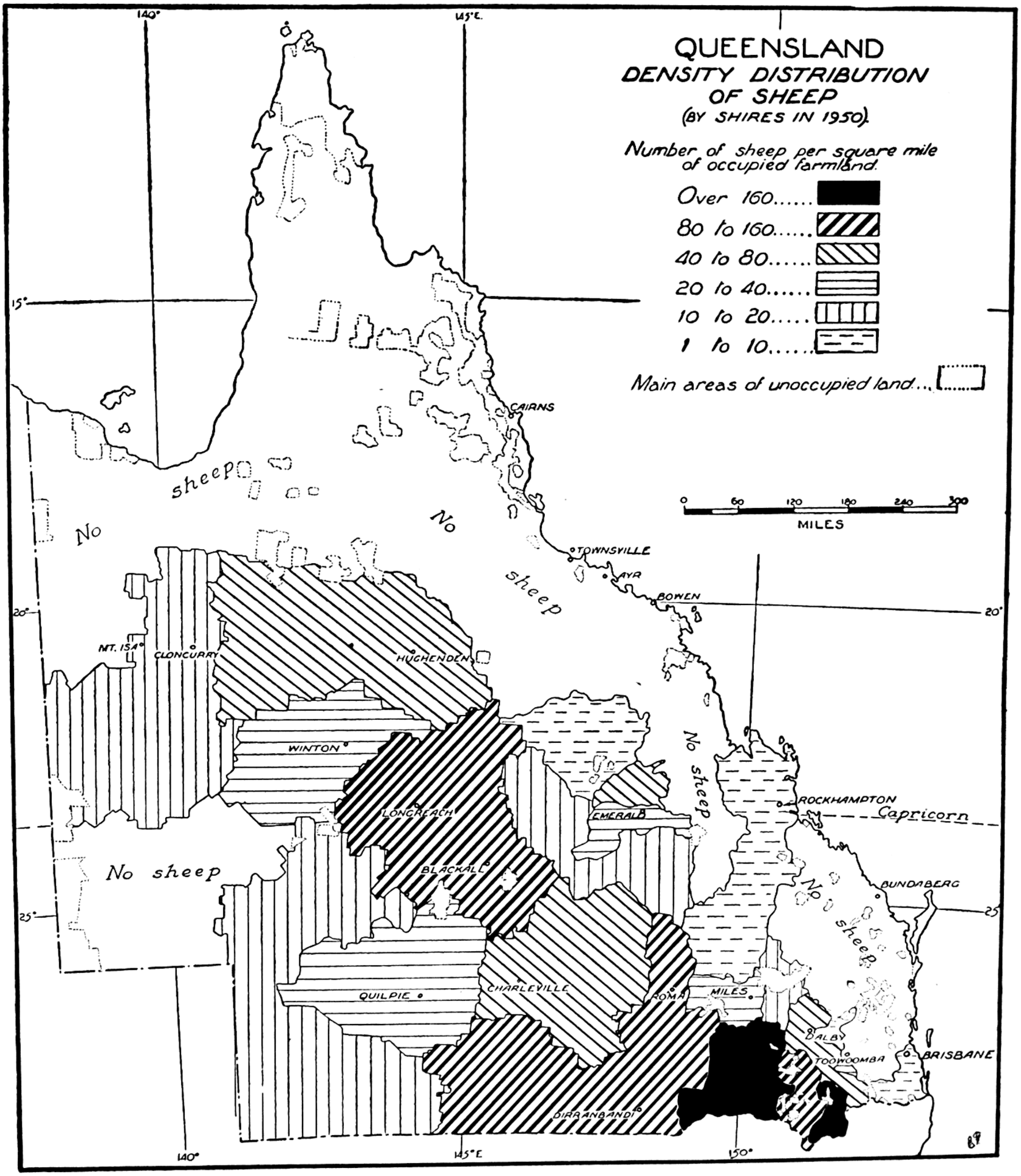

FIG. 69. Density distribution of sheep in Queensland, 1950.

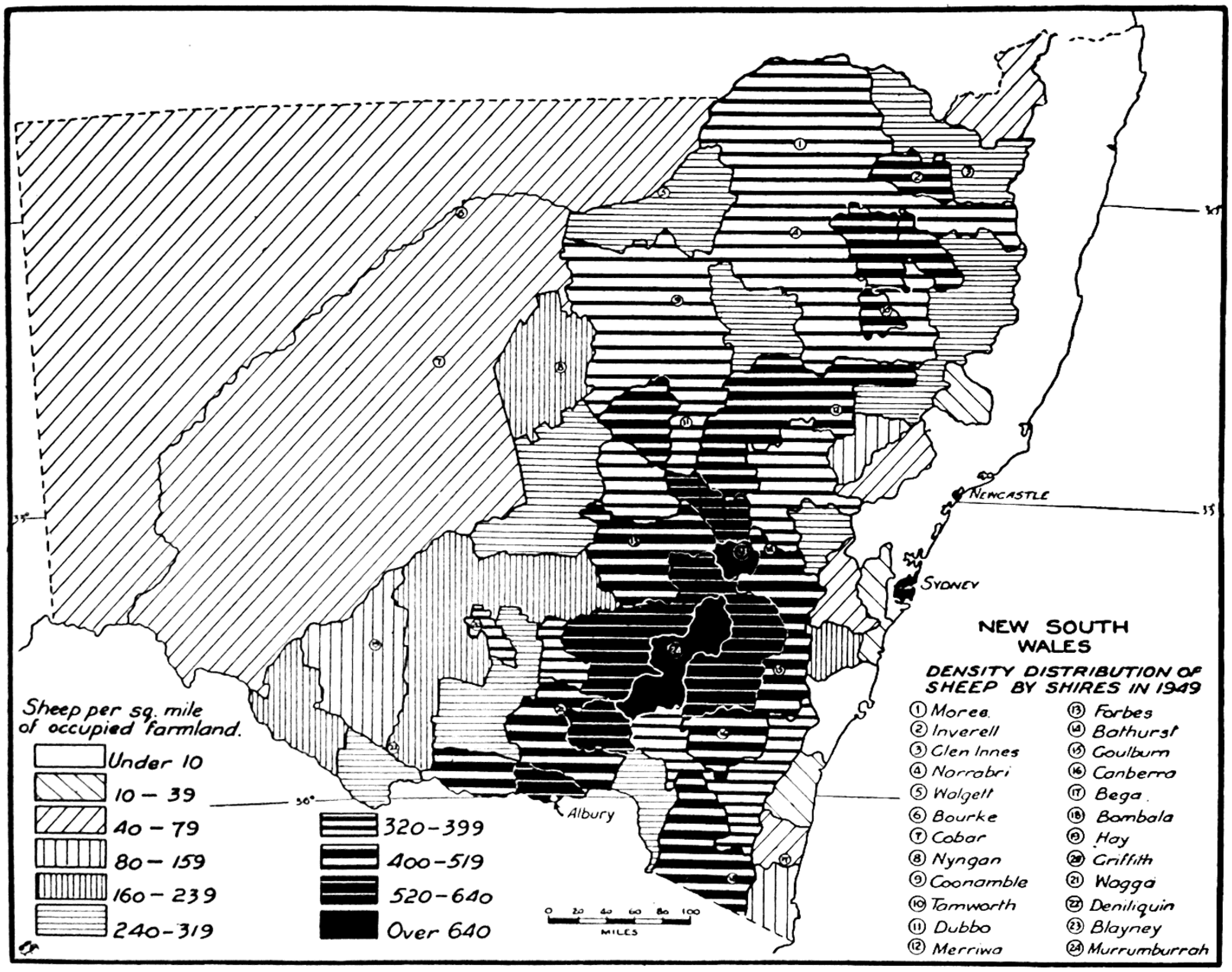

FIG. 70. Density distribution of sheep in New South Wales, 1949.

2. Central New South Wales and northern Victoria. (*a*) This region comprises the plain and hilly land extending through central New South Wales and terminating in northern Victoria. Savanna woodland vegetation is characteristic of much of the country. It receives a fairly reliable rainfall of between 15 and 25 inches a year. Drier areas, as in the south-west of New South Wales, produce mallee and scrub country. Much clearing of the natural cover has taken place to provide more grazing country in the western districts and more extensive wheat-growing and sheep-farming in the east. Both types of agriculture are assisted by irrigation along the Lachlan, Murrumbidgee and Murray rivers.

(*b*) Carrying capacity varies in both States. Much of the country carries about 300 sheep to the square mile. The areas with the higher density, as in the better watered east, reflect important features additional to pure grazing, e.g. wheat-growing, pasture improvement and fodder conservation of lucerne and clover (see Figure 68) with some beef cattle raising. By way of contrast, in the parts with the lower density, as between the Lachlan and the Darling and in north-west Victoria, neither wheat-growing nor fodder storage is feasible and stations concentrate on the production of wool sheep only.

3. Western Victoria. (*a*) This region is largely basaltic plains which receive between 20 and 30 inches of rain a year and have a plant cover of tuft grasses and sparse but good herbage.

(*b*) A considerable portion carries over 600 sheep to the square mile. The sheep consist mainly of fine-woolled merinos in the drier parts and crossbreds in the wetter areas.

(*c*) In recent years there have been marked changes in land utilization in these districts, leading to higher efficiency in the farming economy and a wider range of agricultural activities other than wool-growing, e.g., development of stud farms, sales of stock and fat lambs, and the growing of wheat, oats and clover for grains and winter feed.

In the eastern portions of both States there are areas where few if any sheep are raised. This is because of (*a*) the forested and rugged nature of the highlands,

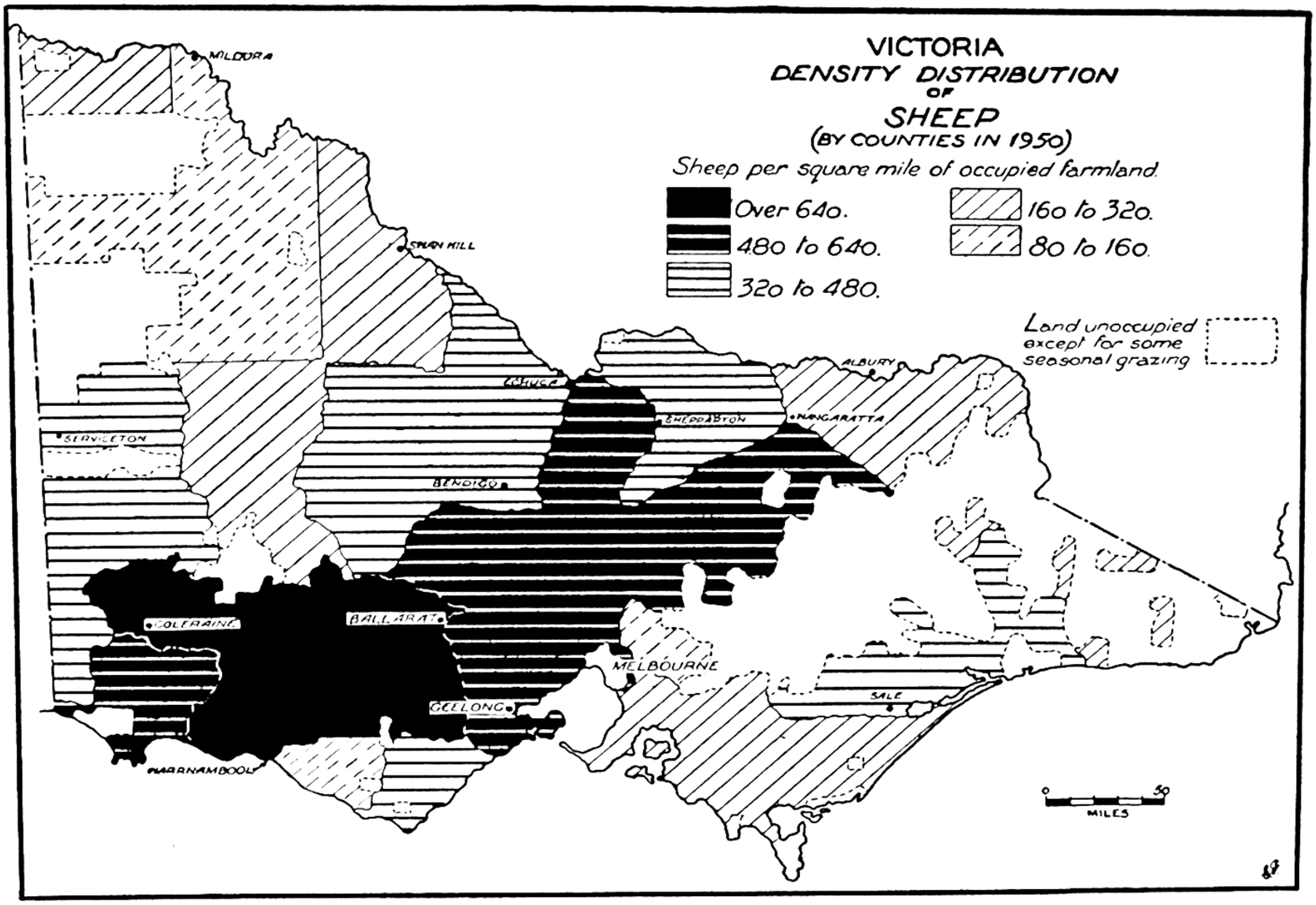

FIG. 71. Density distribution of sheep in Victoria, 1950.

where only seasonal grazing is possible; and (*b*) the rainy conditions of the coastal plains. Production is limited almost entirely to mutton sheep. Reference to Figures 63, 64, 103, 107 and 109 shows that beef and dairy cattle are the main animals in the farming of the eastern districts.

Movement of wool in New South Wales. Commercial farming activities naturally require transport to move their products to markets. Figure 72 shows the pattern of rail transport routes associated with wool production in New South Wales. The following points should be noted:

(*a*) Though there are local selling centres at some inland towns and at Newcastle, over 90 per cent of the wool moves to Sydney. Here, after the wool sales, an average of 12 per cent is forwarded to the local mills and the balance is exported overseas.

(*b*) The main flow of wool is from the central regions of the State. This should be correlated with the density distribution map (Figure 70).

(*c*) The movement is largely seasonal, commencing in August, after shearing has finished in the north, and continuing through the spring and summer until March or April of the following year.

(*d*) Bourke, Walgett and Condobolin are collecting centres for the large areas inland beyond them not served by railways.

(*e*) Wool from the southern Riverina moves to Melbourne as the nearest selling and exporting centre for the region.

A sheep-raising property in New South Wales. Figure 73 is a sketch map of a sheep-raising property situated 68 miles north-west of Condobolin on the Condobolin-Nymagee road. The following features should be noted:

(*a*) It is in granitic hilly country in an area of approximately 16 inches average annual rainfall. The granite hills run through the northern portion of the property. The south, east and south-east have much flat or slightly undulating land. Here the soil is alluvial and consists mainly of grey-brown earth of considerable depth.

(*b*) The fodder is of summer herbage such as corkscrew, summer grass and giant couch and winter herbage such as crowfoot.

(*c*) The property is drained towards the north-east by Pangee Creek and several smaller creeks. These are really dry watercourses (cf. Arabian wadis) from three to thirty feet in depth. They run strongly for several

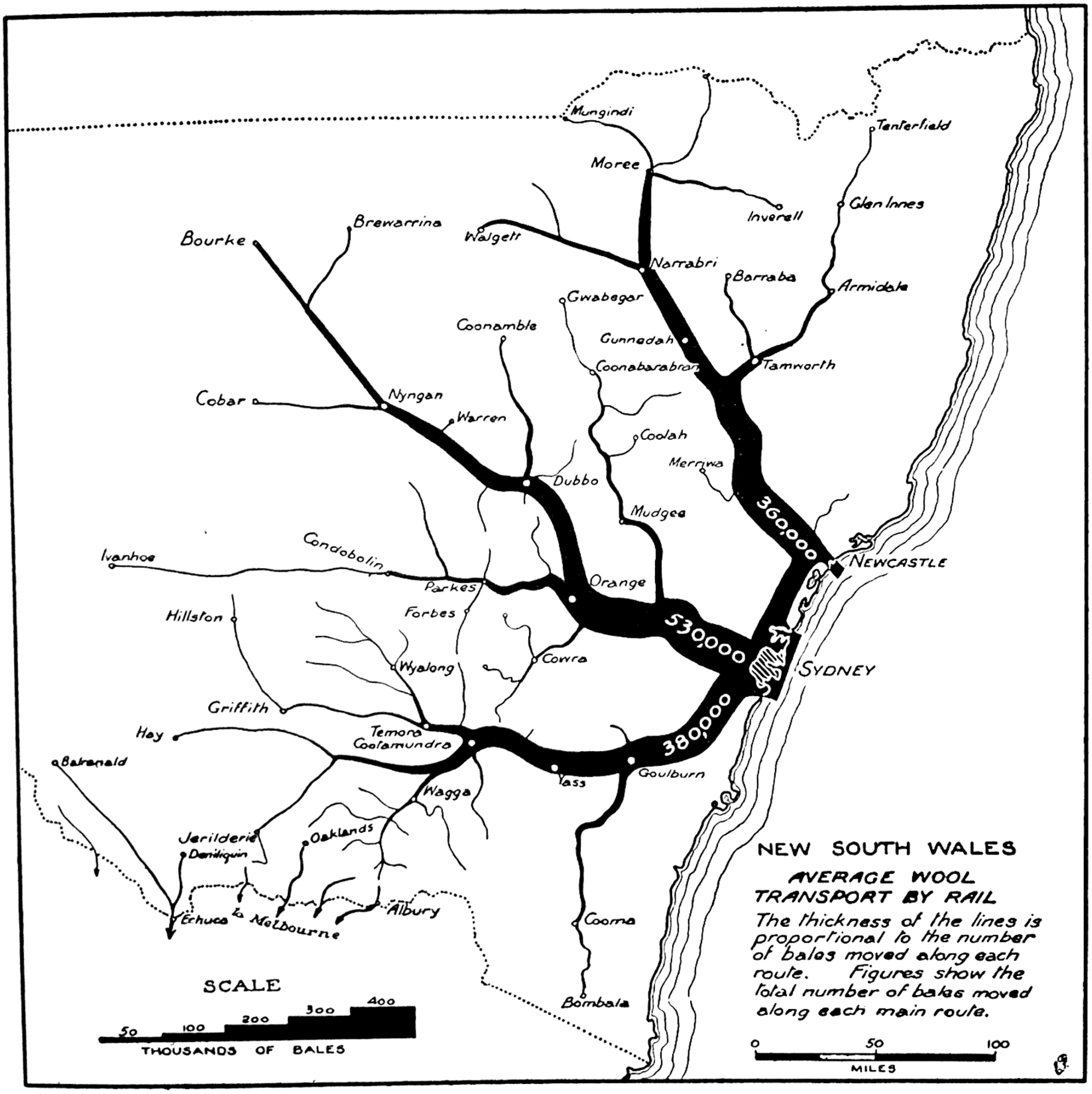

FIG. 72. Average transport of wool by rail in New South Wales.

days after heavy rains, i.e., storms yielding over three inches of rain.

(*d*) The subdivision of the property into ten paddocks is to allow for rotational grazing. The homestead paddock is used mainly for overnight grazing for the few milking cows kept to supply the family with fresh milk.

(*e*) Each of the subdivision paddocks has drinking water for stock from either dams on the creeks or excavated paddock tanks up to 15 feet in depth. In some cases the paddock tank or dam is placed in the corner of the paddock. This is not as satisfactory as the centrally placed tank, since it does not encourage uniform grazing of the paddocks.

(*f*) There are two sheep-yards fairly centrally placed in the northern and southern halves of the property. These are used for drafting the animals from time to time and for inspection of the sheep for blowfly strike and grass-seed infection in the eyes.

(*g*) The house, of weatherboard with six rooms, has a vegetable garden and small orchard. These are watered from an overhead tank supplied by a windmill pumping from the large dam on Pangee Creek. The other buildings and the woolshed are typical of sheep properties.

(*h*) The fences on this property are not netted, mainly owing to the expense being too heavy for the owner to bear. Rabbits have at times created a fodder shortage. The rabbits would be difficult to control, as

the several creeks form excellent cover and breeding places for them.

(*j*) The generally safe carrying capacity of 2,000 sheep and 20 to 30 cattle is rather low for this type of country. This is due to:

(*i*) rabbit damage to fodder;

(*ii*) lack of pasture improvement other than ringbarking of the timber;

(*iii*) absence of fodder conservation schemes. The scanty and erratic rainfall makes the inauguration of such schemes problematical.

(*k*) The wool is sent to the railhead at Condobolin by motor lorry and is sold in Sydney. Condobolin and Tottenham are the main trading and service centres for the owner and his family.

(*l*) The owner does all the work on the property. Casual labour is employed at shearing and for work such as fencing or tank-sinking.

Mandurama township. We have seen that the activity of commercial farming creates a need for transport routes to move the products of the farm to the markets. It also brings about the development of villages, townships and towns as railhead forwarding points for farm products and as trading and service

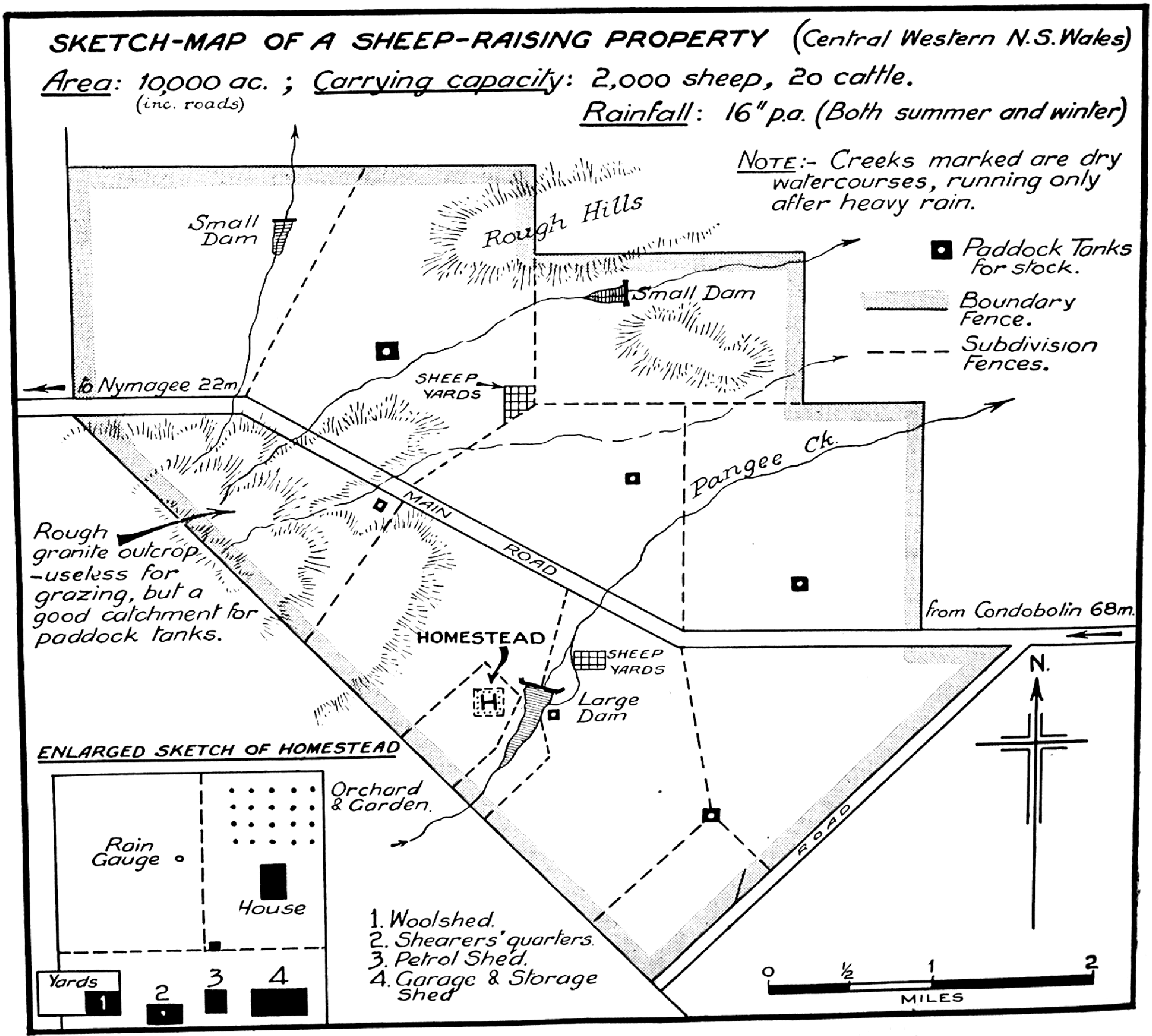

FIG. 73. Sketch-map of a sheep-raising property in central-western New South Wales.

centres to supply the needs of farmers as consumers.

In any farming area, such as the wool-wheat belt of New South Wales, there is a scattering of such agglomerated settlements throughout the farmlands. These may be grouped into four main classes:

(*a*) At important focal points are found large centres with populations of over 5,000. These may be regarded as sub-regional centres. Most of the larger centres have processing and manufacturing industries of some importance. Where the pattern of settlement shows a main street devoted to trading and service activities surrounded by a residential built-up area, such settlements are called towns. In places where these functions have added to them a fairly important industrial activity the settlements may be called cities. Moree, Forbes, Temora, Cootamundra and Narrandera would be regarded as towns, while Tamworth, Dubbo, Orange, Bathurst, Goulburn, Wagga and Albury may be called small cities.

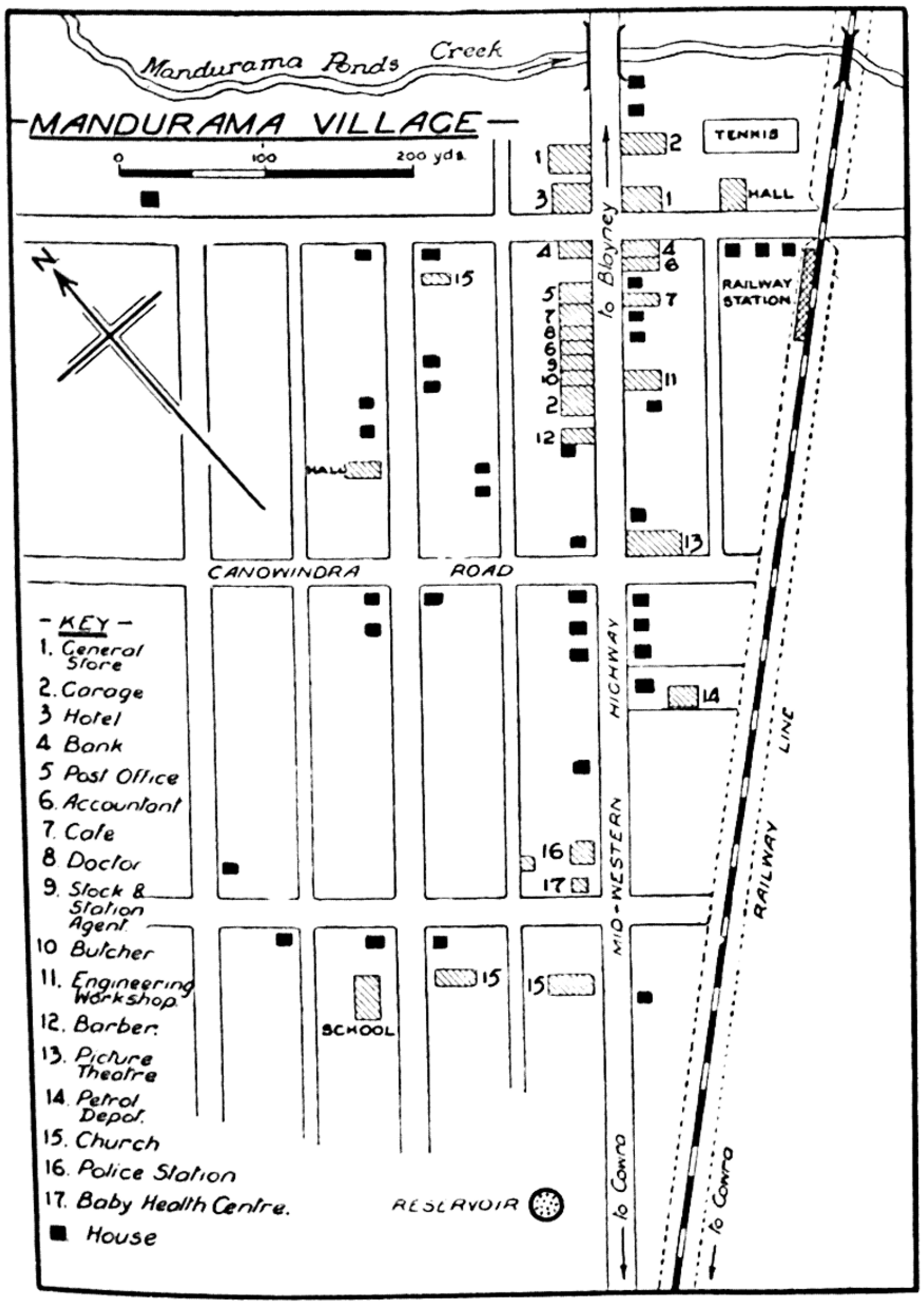

FIG. 74. A sketch-plan of Mandurama township.

(*b*) Scattered away from these are numerous smaller centres, usually with populations of from a few hundred to about 4,000, which act as central trading and forwarding points for smaller districts surrounding them. The smaller centres, with populations of approximately 400 to 700 are called townships. When the population rises to 1,500 they are towns. In all of these settlements the pattern is one of a main trading street surrounded by a residential built-up area. In the smaller ones the number and variety of trading and service establishments is not very great, but the larger centres show both a greater variety and a greater diversification of such activities.

(*c*) Among the smaller towns and townships, and beyond them in the sparsely settled grazing lands, are the villages or hamlets. In them may be seen the first evidence of the development of the basic trading and service functions. These have been created by the needs of the farming populations supporting them. In the early stages of development these functions are few in number, but they become more numerous and more specialized as the villages grow in size with the opening up and closer farming settlement of the surrounding district, until finally they show the many varied and separate functions of the township or the town.

The village or hamlet has usually a few basic fundamental forms. A typical one may contain a general store (often with the Post Office and a branch of the Commonwealth Savings Bank in one corner of it); a hall (where dances and social functions are held); a church; a small school and possibly a hotel. In addition there may be some ten or a dozen houses wherein live storekeeper, teacher, minister and some farm labourers who obtain their living by casual labour on the nearby farms and stations.

Mandurama, the plan of which is shown in Figure 74, and which serves a fat-lamb and mixed-farming region on the western slopes of New South Wales between Blayney and Cowra, is an example of a small township. Here we may see a certain plurality of functions and a tendency towards specialization in certain services. This is evidenced by the presence of a doctor, a cafe, a butcher, an engineering workshop, a barber and a picture theatre. There is little of the specialization in the retail trade usually found in towns, for the stores are general stores and there are no places devoted to personal services (dry-cleaners, laundries or ladies' hairdressers) as would be found in a town. The population of 420 (in 1947) is hardly large enough to permit the title of town being applied to it.

Students will find it a very interesting and helpful exercise to map such villages and townships as may occur in their district, and to relate the functional forms in them to the surrounding countryside and its farming activities. Such a direct relationship is found in Mandurama in the banks, stores, churches, school, accountants (mainly concerned with income tax work), stock and station agents, engineering workshops (where cars and agricultural machinery are repaired and reconditioned), petrol depot, doctor and baby health centre.

COMMERCIAL GRAIN-FARMING IN AUSTRALIA

World distribution. Commercial grain farming is a nineteenth-century development. It aims at the large-scale production of marketable grains both as human and animal foodstuffs. Although wheat is the major cash crop, there are also other stock and crop associations in such regions, e.g., rice, oats and hay (for domestic and draught animals), rye, barley, corn and flax, vegetables and fruit.

In studying Figure 75 the following points are worth noting:

1. The major commercial grain-farming regions of the world are on the higher rainfall grasslands and woodlands of the middle latitudes of the Americas, South Africa, Eurasia and Australia. The most productive parts are usually well inland, between humid climates producing a mixed farming economy and semi-arid climates favouring commercial grazing. The main exception is the cultivation of rice as a cash crop in southern United States, California and the Murrumbidgee Irrigation Area of Australia.

2. Although the regions shown are depicted in a generalized manner, the following details should be observed:

(*a*) In Kansas and nearby States in the United States and the Ukraine (U.S.S.R.), winter wheat is the main crop cultivated. Winter wheats are long-seasoned varieties, i.e., late maturing and requiring a long growing period. They are sown in the autumn or early winter and shoot before the winter cold sets in. They are very hardy to snow or frost and when the winter is over they make very rapid growth.

(*b*) In places where the winters are longer and colder, i.e., the Dakotas (U.S.A.), the prairies of Canada, western Siberia and the south-east of Russia, spring wheat is the major crop. Spring wheats are early maturing (short-seasoned) varieties, and are sown in the spring.

(*c*) In Australia and the Argentine short-seasoned spring types are used because the growing season is restricted by rainfall. These countries grow spring wheats as a winter crop.

(*d*) In marginal lands, where the rainfall tends to be low and erratic, fallowing is practised with short-seasoned drought-resistant varieties. Frontier farming is also carried on where special wheats have

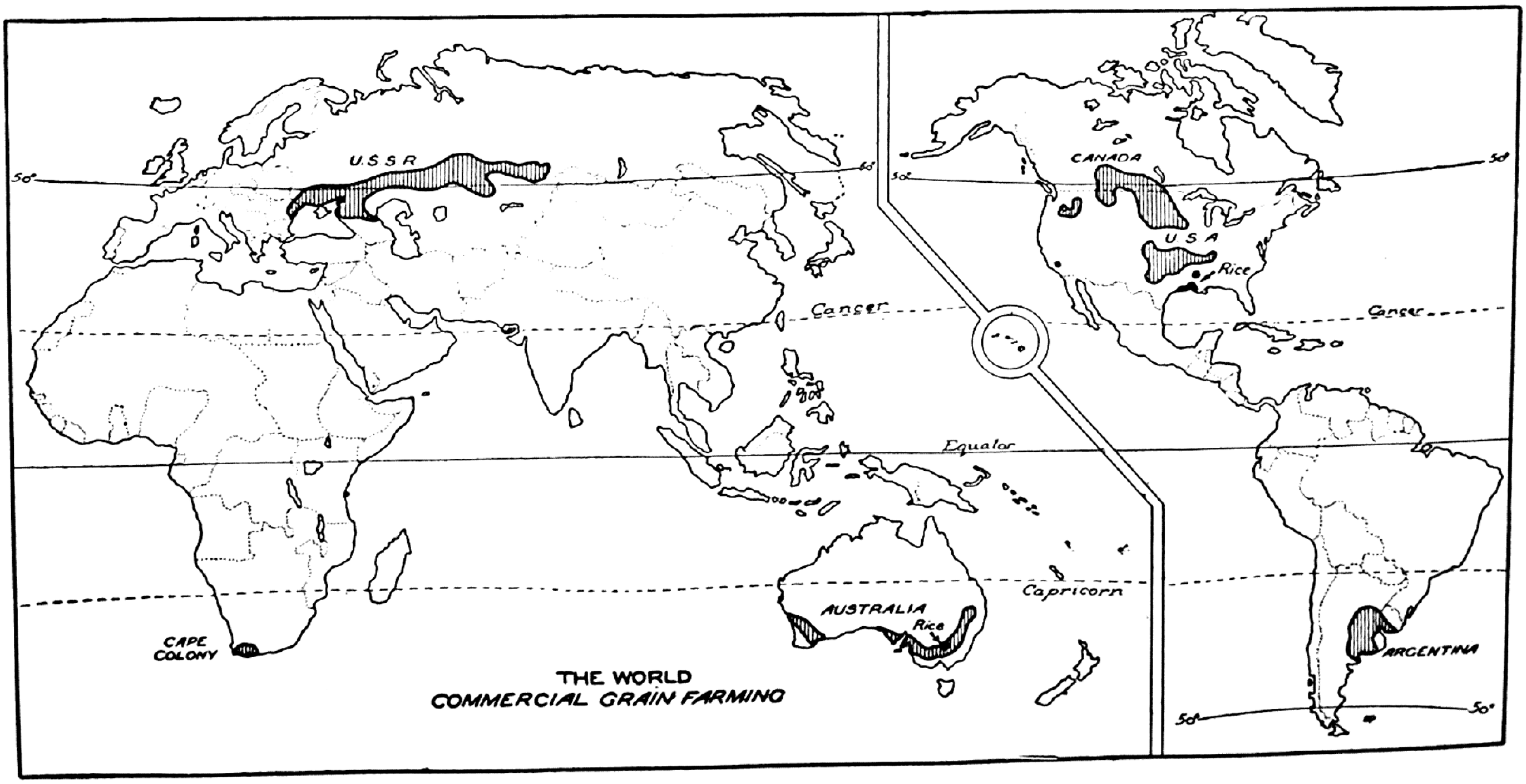

FIG. 75. Commercial grain-farming areas of the world.

been adapted to the rigorous cold and short growing seasons of northern Canada.

3. These farmlands were once occupied by nomadic herders or livestock ranchers. The almost complete change-over to arable agriculture was the result, among other things, of: (*a*) a greater world demand for foodstuffs; (*b*) flat or undulating landforms favouring extensive and mechanized cultivation; (*c*) suitable climate and soils with satisfactory seasonal rainfall; and (*d*) the cheap purchase price of land in earlier days.

4. On the whole, commercial grain-farming on the new and relatively cheap agricultural lands of the world has produced a typical European rather than an Oriental pattern of occupancy.

(*a*) Farms are usually large in size when compared with those of crop and livestock farming or the fruit and market-gardening areas described in later chapters, and especially large when contrasted with those of Oriental farming regions.

(*b*) There is a considerable emphasis on animal husbandry for farm work, e.g., horses; as a source of food supply, e.g., cows and pigs; as a supplementary source of income as with sheep in Australia; and for the maintenance of soil fertility.

(*c*) Machinery (especially tractors, replacing horses) plays a big part in the farm activities, so that one farmer is thereby enabled to work an extensive area of ground profitably and the cost per unit of product is surprisingly low. This is the only type of farming possible and profitable on the marginal agricultural land.

(*d*) The various grains like wheat, barley, oats, rye and flax are grown with comparatively low production costs and a minimum of human labour, which consists generally of the owner, one or two employees and additional help for the harvest. The average yield per acre is usually low, so that these areas have a low average production per acre and a very high output per person. These features are in marked contrast with the subsistence farming lands, which generally have a high average production per acre and a very low average per person.

(*e*) Transport facilities, both road and rail, are essential to the economic development of the commercial grain-farming regions. It has been found unprofitable to grow wheat more than 20-25 miles from a rail shipping centre, so that wheat lands, for example, are generally criss-crossed by networks of railways. Good roads link all farms with the railheads. Examples of such transport patterns will be seen in later detailed studies. (See Figures 84, 85 and 93.)

(*f*) Because of the emphasis on cash crops, few of these regions have any degree of self-sufficiency in foodstuffs, as is the case in Oriental farms. Much is brought into the districts from other areas, except perhaps in the case of the collective farms of the U.S.S.R.

(*g*) Since the acreages are often large, farmsteads are widely spaced and characterized by small houses and a few sheds, since storage of grain is not necessary, but equipment must be maintained. Here again there is an interesting contrast with the pattern of land

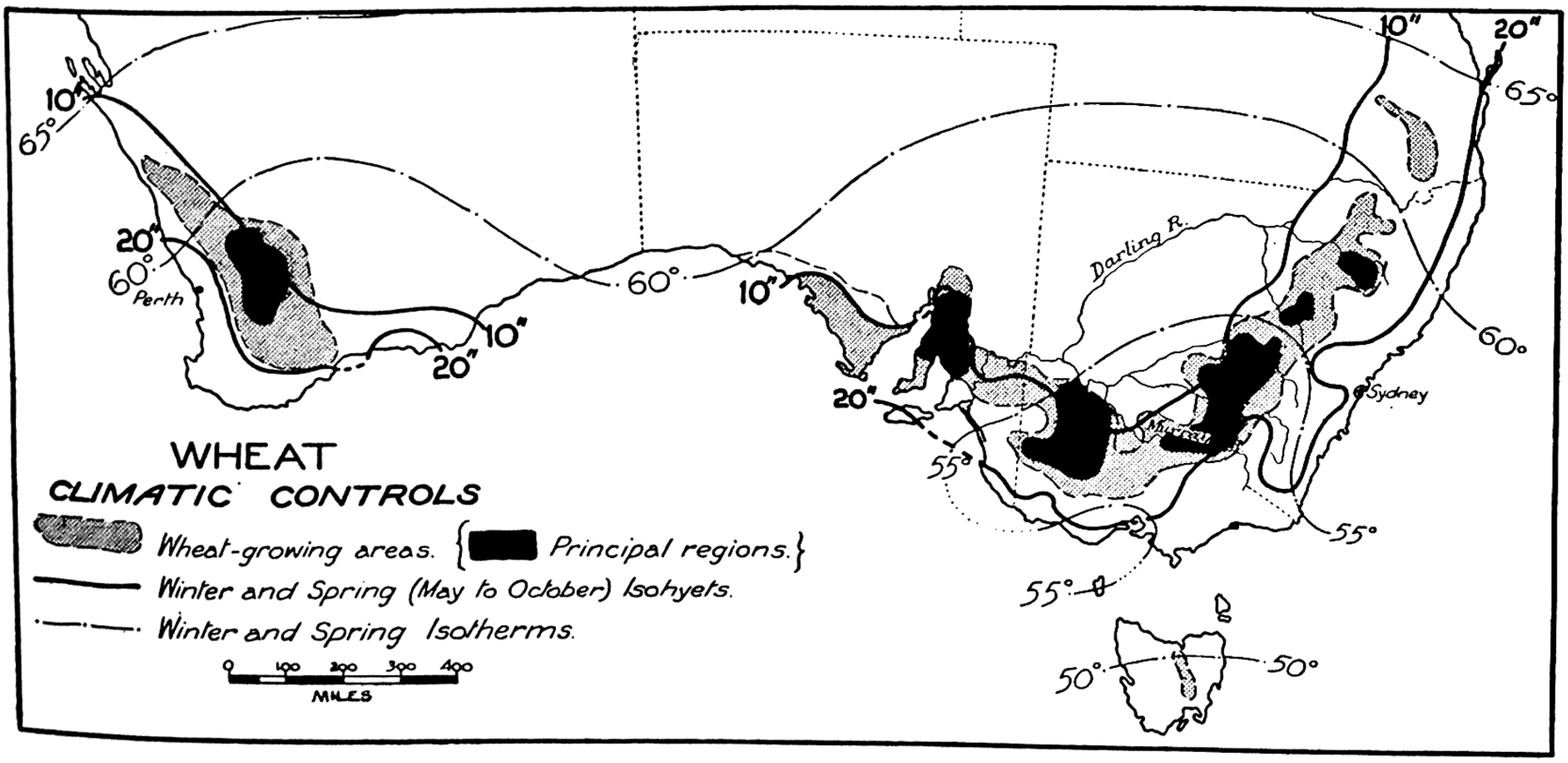

FIG. 76. Wheat distribution and its climatic controls in Australia.

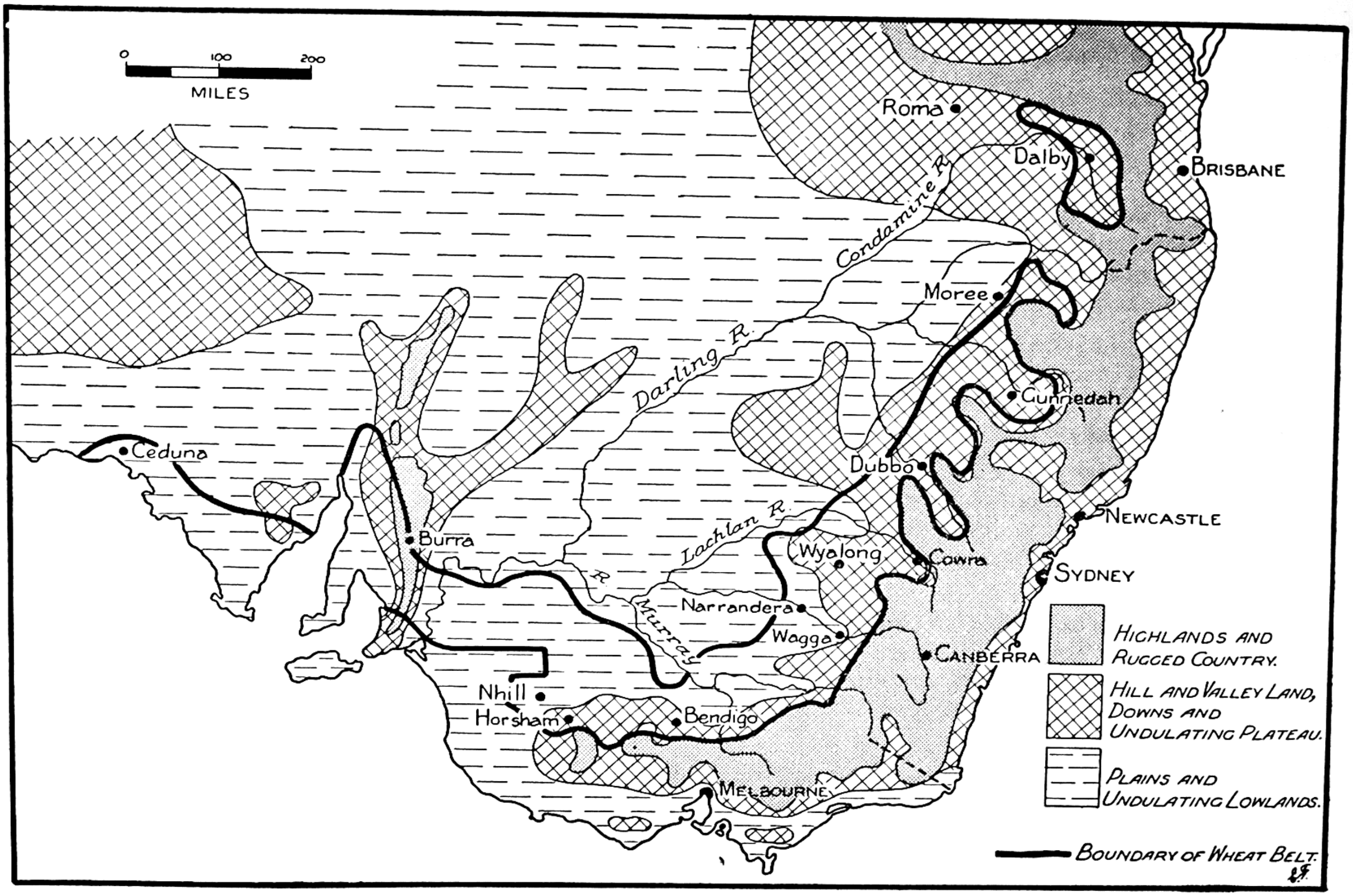

Fig. 77. Principal landform types in the wheatlands of south-east Australia.

occupancy as seen in Oriental subsistence farming. In the U.S.S.R. the workers' central village is a feature, since the collective system absorbs the scattered households of the smaller peasantry.

Wheat-growing in Australia. General. As in the United States and Canada, wheat-farming in Australia is a highly commercialized enterprise, on a large scale, individualistic and mechanized. Similarities are also to be seen in the growing use of supplementary crops, the presence of large numbers of farm animals, the use of fallowing methods of soil preparation in marginal lands, and the function of service and wheat storage settlements in a characteristic wheatlands network of railways. There are, too, several interesting contrasts. There are no vast areas of rich soils as on the American prairies, but rather patches of good country separated by land unsuitable to wheat. Wool sheep and fat lambs figure more in the Australian scene. Where the wool-wheat belt is most highly developed there is more of a livestock and crop farming economy approximating to the corn belt of the United States.

Location. Figure 76 shows how the wheat-growing lands of Australia occur in the south of the continent and are entirely inland except in South Australia, where farms reach the sea. The relative portions of the belt in each State should be checked by reference to the political boundaries indicated, and the rest of the map series will give precise details. The position of this greatest area of cultivated fields in the country is governed by several important geographic and economic factors.

Geographic factors. 1. Topography (Figure 77). This map of the south-east landforms, with wheat belt boundary lines superimposed, shows how the farming is done on types of country ranging from hill and valley to plains topography, but generally with an undulating character suited to mechanized farming. Certain exceptions may be noted, as in the Darling Downs of Queensland and the Flinders Ranges of South Australia.

2. Climatic controls (Figure 76). Winter and spring rainfall lines are noteworthy here because of the great seasonal importance of precipitation. Australian wheat has either a winter-spring or an autumn-winter-spring period of growth. This means that in the farming routine, good reliable well-spread rains are needed in the sowing (autumn and winter) and early growing

seasons, with another series of falls in the maturing stage (spring and early summer). Reliability is particularly important at this last-mentioned stage, when the ears are being filled, and rains then can make or mar yields. Harvesting demands good dry weather. Heavier rainfall is required in the warm areas than in the cooler southern parts because of the greater evaporation. In northern New South Wales and southern Queensland there is a summer rainfall maximum which sometimes causes difficulty in ripening and harvesting the crop. Extensions beyond the 10-inch line in the west represent marginal wheat-land areas, and are virtually frontier agriculture, with all its problems of crop failure and soil erosion.

The temperature factor is not as important here as in North America, which suffers extreme winters and summers. Severe frosts are exceptional and high humidities favourable to disease are not frequent. The isotherms on the map are intended to show that winter months actually permit growth and that the onset of spring and early summer temperatures provides the necessary warmth and sunshine for forming the ears and ripening the grain.

3. Soils (Figure 78). The detailed map here brings out several interesting facts concerning the soils of the wheat belt.

(*a*) The grain is grown over a very wide range of soil types, though the main ones are the loamy red-brown earths, black earths, grey and brown earths and the mallee soils.

(*b*) Podsols are not utilized to the same extent as in European farming, though they are included in the wheat belt of Western Australia.

(*c*) Soils farmed outside these types have not proved satisfactory. Sandy soils have had to be abandoned because of severe wind erosion. Heavy clays have reverted to grazing because of the loss of soil structure due to overcropping, leading to high cost of cultivation.

(*d*) The physical character of soils is important to farmers who demand easily worked surfaces for machinery and retentive subsoils for the conservation of moisture, a significant aspect of fallow-farming under conditions of low and unreliable rainfall.

(*e*) Arising out of the economic experience of individual farmers working under a particular environment, methods of production have been adapted to meet the varying character of climate and of soils, e.g., the use of superphosphate and systems of fallowing and rotation. Scientists have assisted greatly by the breeding of wheat plant types suited to different geographical conditions.

(*f*) Soils in these lands do not have the great

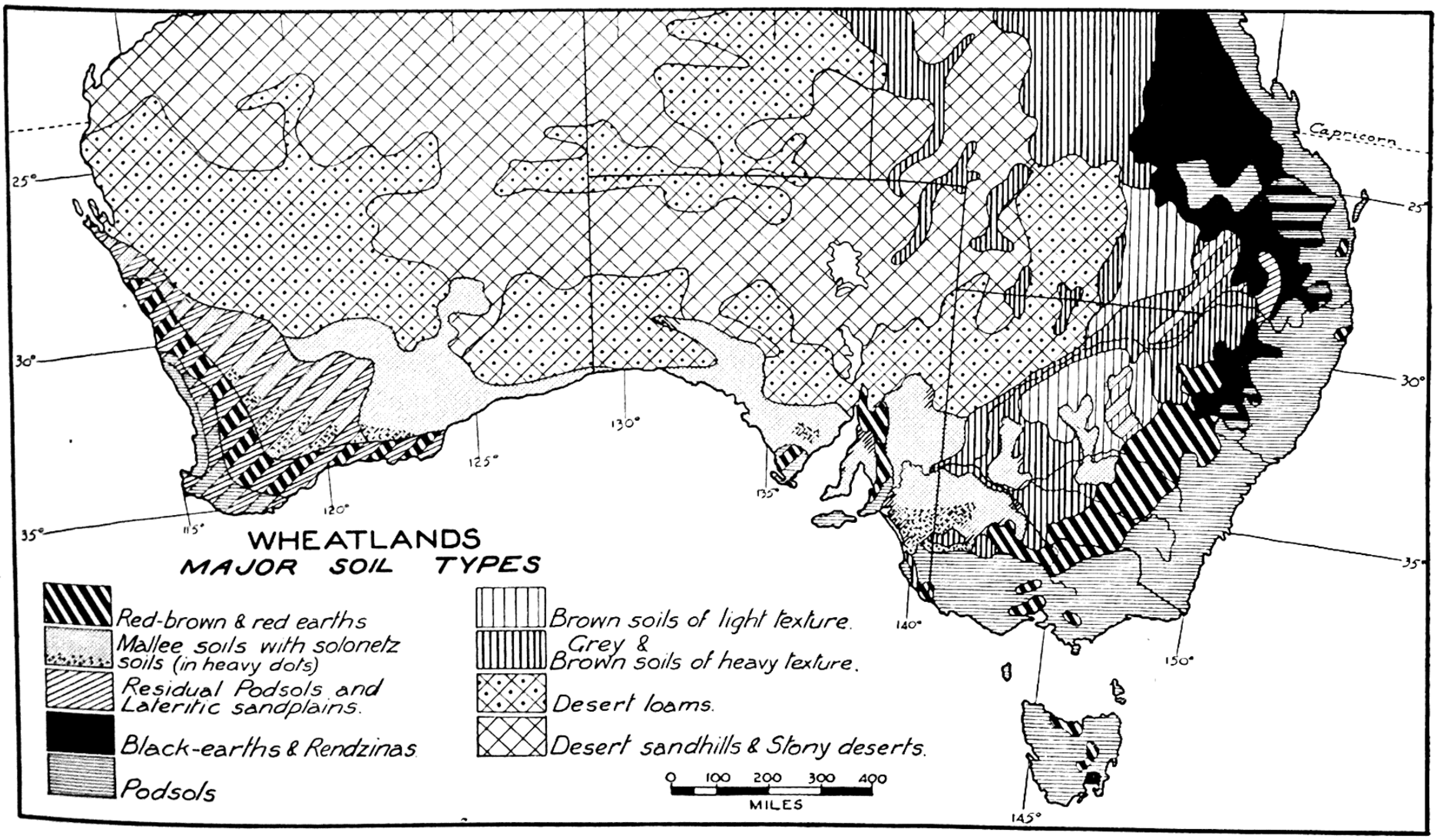

FIG. 78. Major soil types of Australian wheatlands and adjoining areas (*After J. A. Prescott, C.S.I.R.O.*).

extent of the grain-farming regions of North America and the Ukraine. Rather they are spaced, with unsuitable soils between.

(*g*) Because of bad farming practices in the past, certain sections of the wheat belt are among the most eroded in Australia and special reference is made to them in a section dealing with soil erosion.

Economic factors. Geographic conditions have been mainly responsible for the location and farming economy of the wheat belt, but these economic factors are important.

(*a*) Farming of wheat offers a reasonable living from the average property because of its size and the farmer's ability to use machinery efficiently with a minimum of hired labour. Note the number of tasks which can be performed by the modern combine harvester from reaping to bagging the crop.

(*b*) There is a constant local and oversea demand for a grain which has always been a basic foodstuff in Western countries. It is being more widely eaten in some Oriental lands.

(*c*) Storing qualities and improvements in bulk handling have enabled bigger yields to be disposed of.

(*d*) Agriculturists have long advocated the greater use of livestock on wheat farms, especially the use of sheep. High wool prices in recent years have helped to bring about and to some extent consolidate this trend. With price stabilization policy, the wheat farmer is no longer open to the same risks of fluctuating prices. Wheat-growing has tended to decline in Australia because of the relatively higher prices for alternative lines of production, sheep and wool prices being especially important.

Activities associated with the industry. 1. On the farm. (*a*) **Buildings**. The number and size of these varies throughout the wheat belt, but usually include a homestead, several sheds for housing machinery, equipment and seed wheat, and often a hay shed.

(*b*) **Fences.** These are necessary for subdivision especially where sheep and cattle are raised. The boundary fence is often netted to keep out rabbits, and the maintenance of fences is an important routine.

(*c*) **Yearly routine.**

(*i*) Fallowing is still extensively practised. This calls for ploughing the land in the late winter of the year before seeding. The area so prepared is cultivated at intervals to prevent the growth of weeds. Fallowing conserves moisture and renders plant foods, especially nitrogen, more readily available.

Short fallows are being increasingly used in the better rainfall areas. In this case the soil is ploughed in the summer or early autumn. The final preparation of the seed-bed takes place from March or April onwards to the date of seeding, which extends from late April to early July.

(*ii*) The sowing of the crop is usually done in late April and May and June.

(*iii*) Harvesting is frequently done with hired labour and carting of the grain to the railhead by contractors from a nearby town.

(*iv*) Where sheep are kept the yearly routine of work connected with their management is superimposed on that of wheat, e.g., shearing in spring.

2. Outside the farm. (*a*) **Transport.**

(*i*) As in America there is a close network of railways and an intricate road pattern on the wheatlands (see Figure 93 for an example of this in the United States). A study of the railway lines of the Riverina (New South Wales) and Wimmera (Victoria) as illustrated in Figures 84 and 85 will bring out this transport feature. A comparative reference can also be made with the south-western districts of Western Australia. Traffic on these lines reaches a peak from December to March, when the crop is being moved to the ports.

(*ii*) In New South Wales, Victoria and Western Australia most of the wheat is handled in bulk and huge silos are a feature of the railhead forwarding points. There is also a $7\frac{1}{2}$-million bushel silo at the terminal at White Bay in Sydney and a 1-million bushel silo at Newcastle. These storage points for both this State and Victoria are illustrated in Figures 84 and 85. When not handled in bulk the wheat is stacked in bags, either in the open with a temporary iron roof or in permanent sheds. During the harvesting and shipping season large numbers of casual workers are employed by the farmers and railways, and many carriers find extra work.

(*b*) **The town pattern.**

(*i*) The need for shipping points at fairly close intervals (and it has been found unprofitable to cart wheat more than 25 miles to a railhead) has created a special pattern of agglomerated settlements. These owe their existence to wheat-farming, and their inhabitants depend largely on the farmer for their income.

(*ii*) Two main types exist, the hamlet (or village) form and the town form. There are certain definite relations between the two. Within the sphere of influence of each town form there may be a fairly large number of hamlets and the actual number and closeness of their grouping is a reflection of the occupational development of the region. The more complete the development of the farming activity, the more closely settled

is the farm land and the greater the number of hamlets and towns.

(*iii*) The towns have a variety of functions and also a definite town plan which marks them out from the hamlet. In most cases the plan is rectangular and there is a fairly definite zoning into a shopping zone and a purely residential zone. The existence of the residential zone also marks out the town from the hamlet.

(*iv*) The towns cannot be regarded as collecting centres for the district around them, since the goods produced in the district are usually sent to the nearest siding, so that the town receives only a share of them. They are distributing centres because much of the purchasing for personal, home and farm needs is done there by people from all parts of the district. They thus form a link between the farmers and the State capital city.

Wheat Yields in Australia (Figure 79). This map emphasizes very clearly the dependence of wheat on

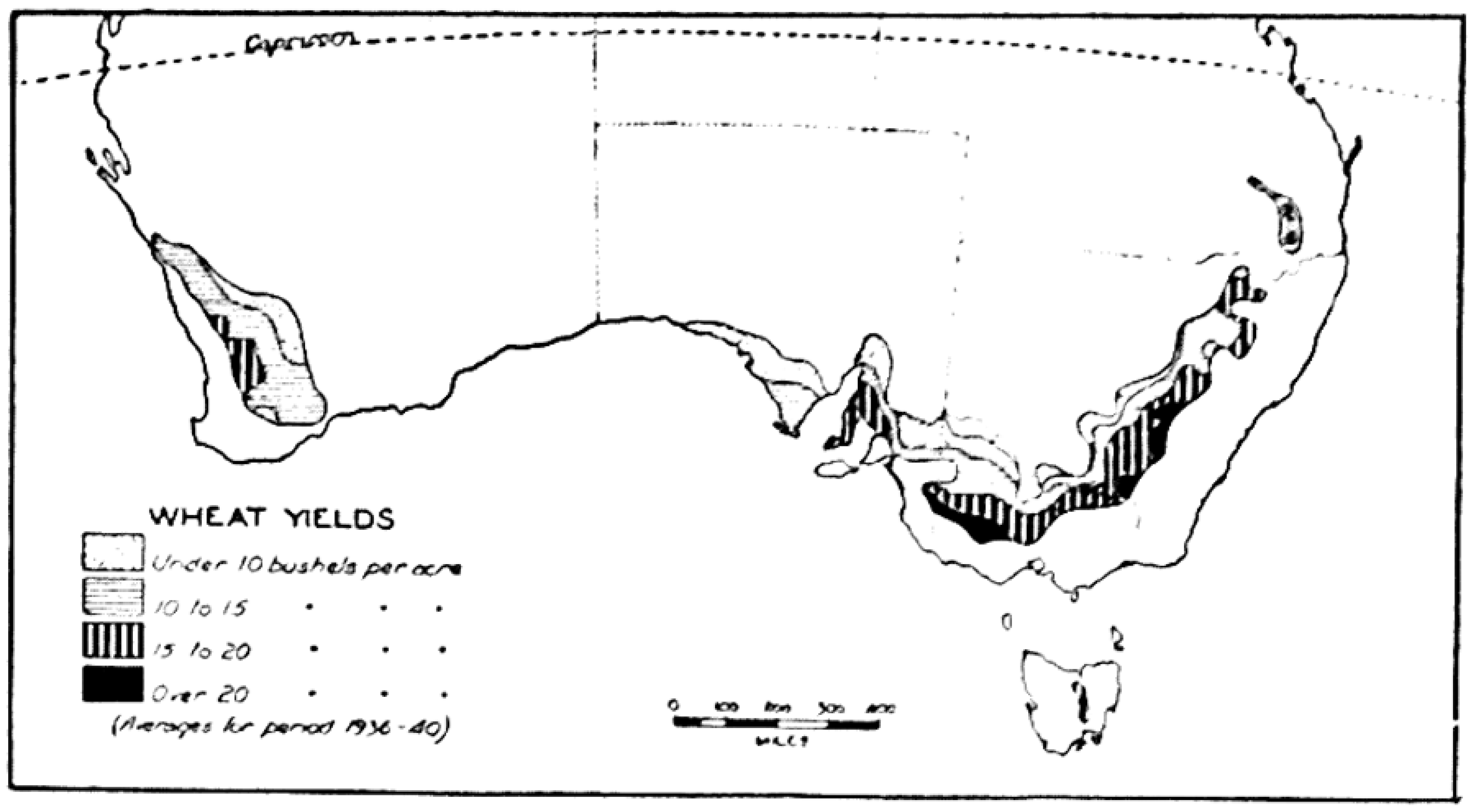

FIG. 79. Average wheat yields in Australia, 1936-40.

rainfall. Comparison with Figure 76 will show that the high yields per acre occur only in those portions of the wheatlands which receive a winter and spring rainfall of approximately 20 inches. Towards the inner margins of the belt, where the significant rainfall approaches 10 inches, the yields are only from five to 10 bushels per acre and crop failures are common. This may be partly explained by the fact that a 25 per cent variation below a 20-inch rainfall still leaves

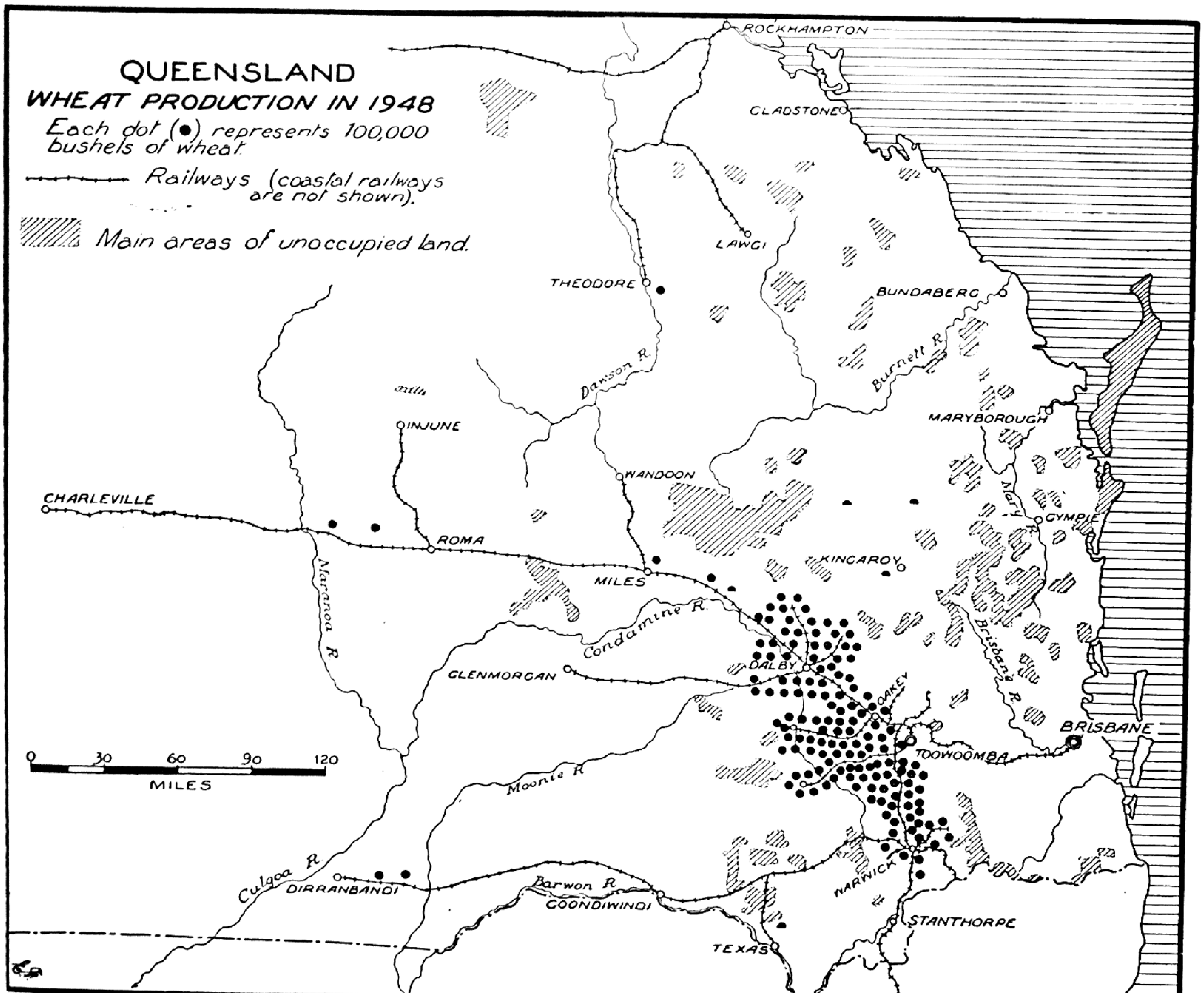

FIG. 80. Wheat distribution and production in south-east Queensland.

sufficient rain to produce a good crop, whereas a similar variation below a 10-inch or 12-inch rainfall results in a crop failure. And a 25 per cent variation below the average rainfall is a fairly common occurrence throughout the wheat belt. Victoria (except for the mallee area) has a higher and more reliable rainfall than most other parts of the belt and its average yields are consistently higher than those of the other States.

A feature not indicated on the map is the wide variation in yield from year to year. It is only rarely that successive seasons receive the right amount of rain at the right times for satisfactory crop growth and the yields vary accordingly.

A further feature which could not be shown on the map is the increase in average yields due to the decline in over-cropping and the use of better varieties and better rotational and manurial methods. Much of the wheatland has been overcropped or insufficiently supplied with chemical fertilizers and in many areas the soil is becoming impoverished because of this. A recent survey in the Riverina (by Ross Parish of the New South Wales Agricultural Department) showed that over 50 per cent of the farmers interviewed stated that declining soil fertility was a major factor in causing reduction of wheat acreages and declining wheat yields.

A comparison with the yields of other wheat-growing countries shows that the Australian average of 15 to 16 bushels per acre compares favourably with that of the other large-scale commercial wheat-farming countries (e.g. Canada, 16; United States, 18; Argentina, 14). These yields are much lower than those of European countries (France, 25; England, 34; Germany, 33). The wheat there is grown on more intensively cultivated smaller farms and as a part of a mixed farming routine using carefully planned crop rotation with the wheat as one of the crops.

Production by States. Queensland (Figure 80). Wheat-growing in Queensland shows several significant geographical features.

1. There is a strong localization in the south-east of the State, especially on the larger fertile farms of the Darling Downs.

2. Limitations upon large-scale wheat-farming in Queensland are imposed by such factors as:

(*a*) the soil types (see Figure 78) e.g., the heavy black earths which are difficult to work when wet, although the better loams of these are valuable on the Downs country;

(*b*) the incidence of summer rainfall, which gives generally unfavourable conditions for wheat-growing. Humid conditions in late phases of the crop favour development of disease, especially rust and mildew.

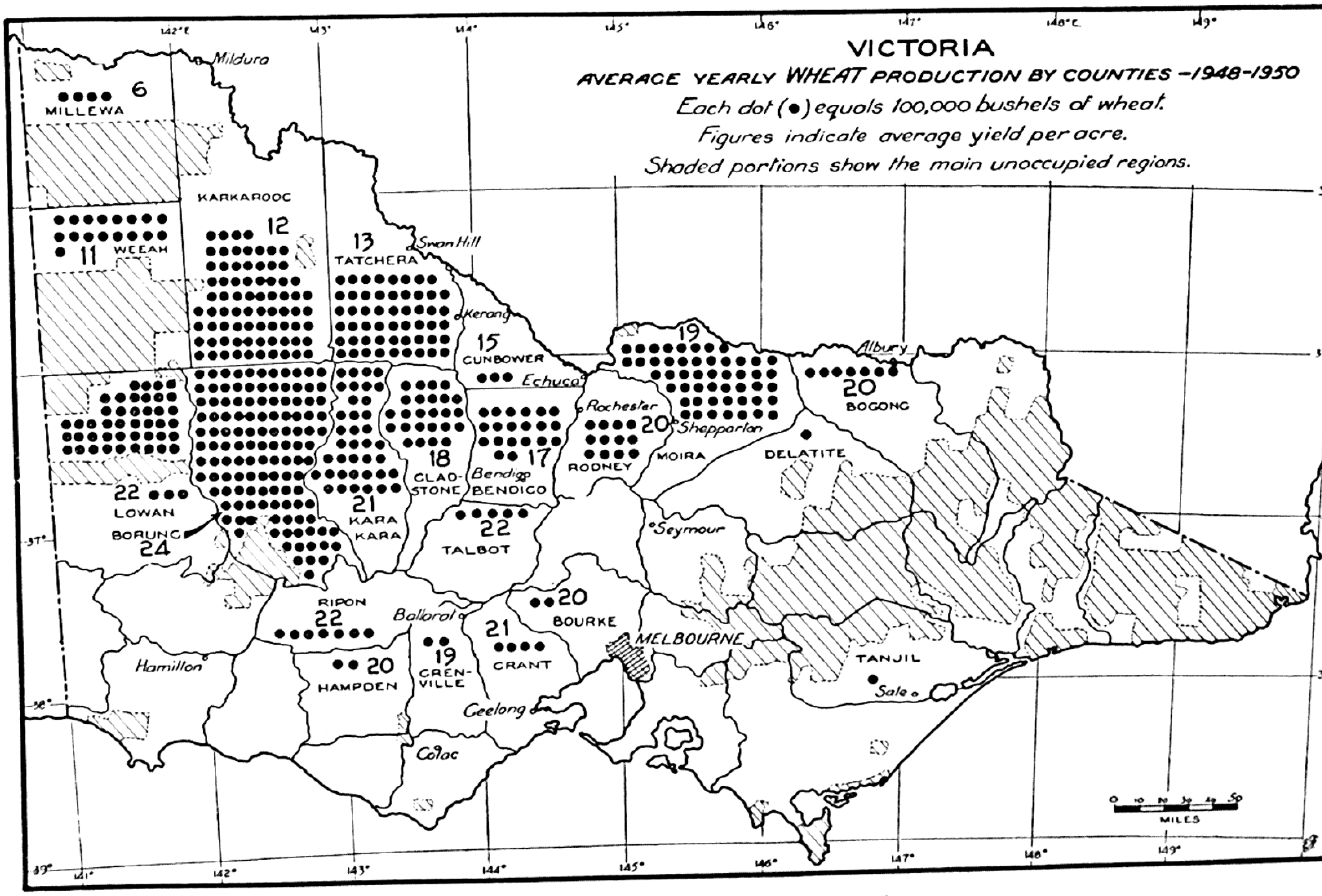

FIG. 81. Wheat production in Victoria.

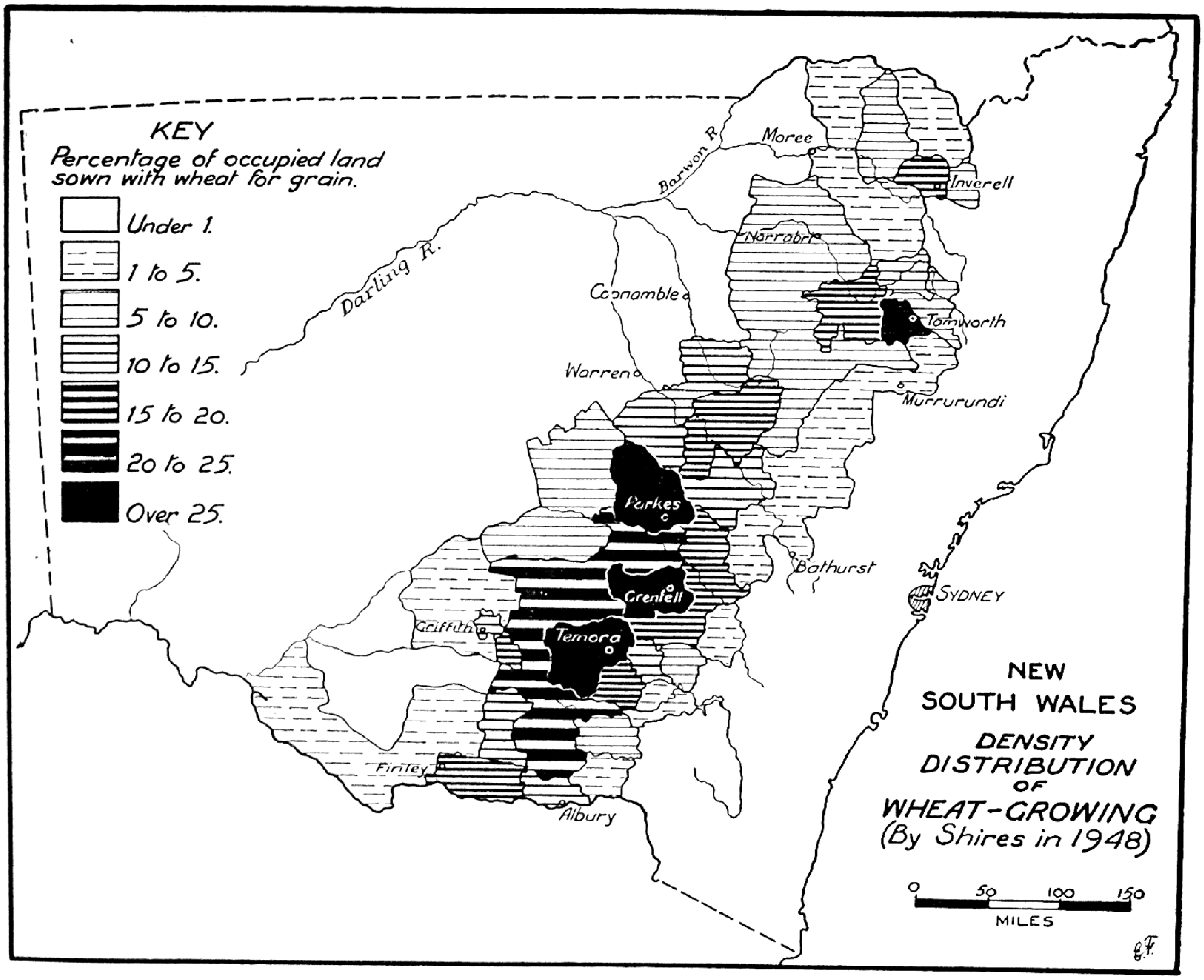

FIG. 82. Density distribution of wheat-growing in New South Wales.

(*c*) the difficulty and expense of clearing new land.

3. There is a small but increasing production because of (*a*) the use of new types of wheat adapted to subtropical conditions, especially those of rain, and (*b*) recourse to dry farming methods. There are possibilities of something like the developments in India, but expansion into unoccupied land (shown as shaded areas on the map) is not easy because these are largely State forests.

4. The inland wheat-growing areas contrast with the rest of the State in terms of settlement, railway pattern, e.g., network as against tentacle lines (for sheep and cattle), marketing and milling centres.

Victoria (Figure 81). 1. Wheat areas are confined to the north and west of Victoria. Most land in the east is too rugged, and to the south the higher rainfall has resulted in more intensive occupancy, e.g., dairying and fat lamb raising.

2. The major area (one of the finest in Australia) is the Wimmera, where very favourable soils and climate have been allied to good farming methods for many years. Mixed farming with crop rotation, weed control, special fallow and ploughing techniques, and the use of chemical fertilizers have now become highly efficient and given this region a unique reputation in agriculture.

3. The northern districts are next in importance. The over-all production is said to have been showing signs of decline for some years. This may be attributed to the tendency of farmers to concentrate on horticultural farming with the advent and development of irrigation there. But there also appears to be evidence of soil deterioration due to faulty cropping over the period when wheat was the sole cash crop.

4. In the mallee areas there were some bad mistakes made by the frontier farmers and properties were abandoned in the drier parts. There has been some stabilization with the introduction of sheep-raising assisted by the channel system of water supply for stock from the Murray (see Figure 133).

5. The unoccupied land of the west has arid conditions which prevent any worthwhile grain farming. Recent developments of soil treatment with trace

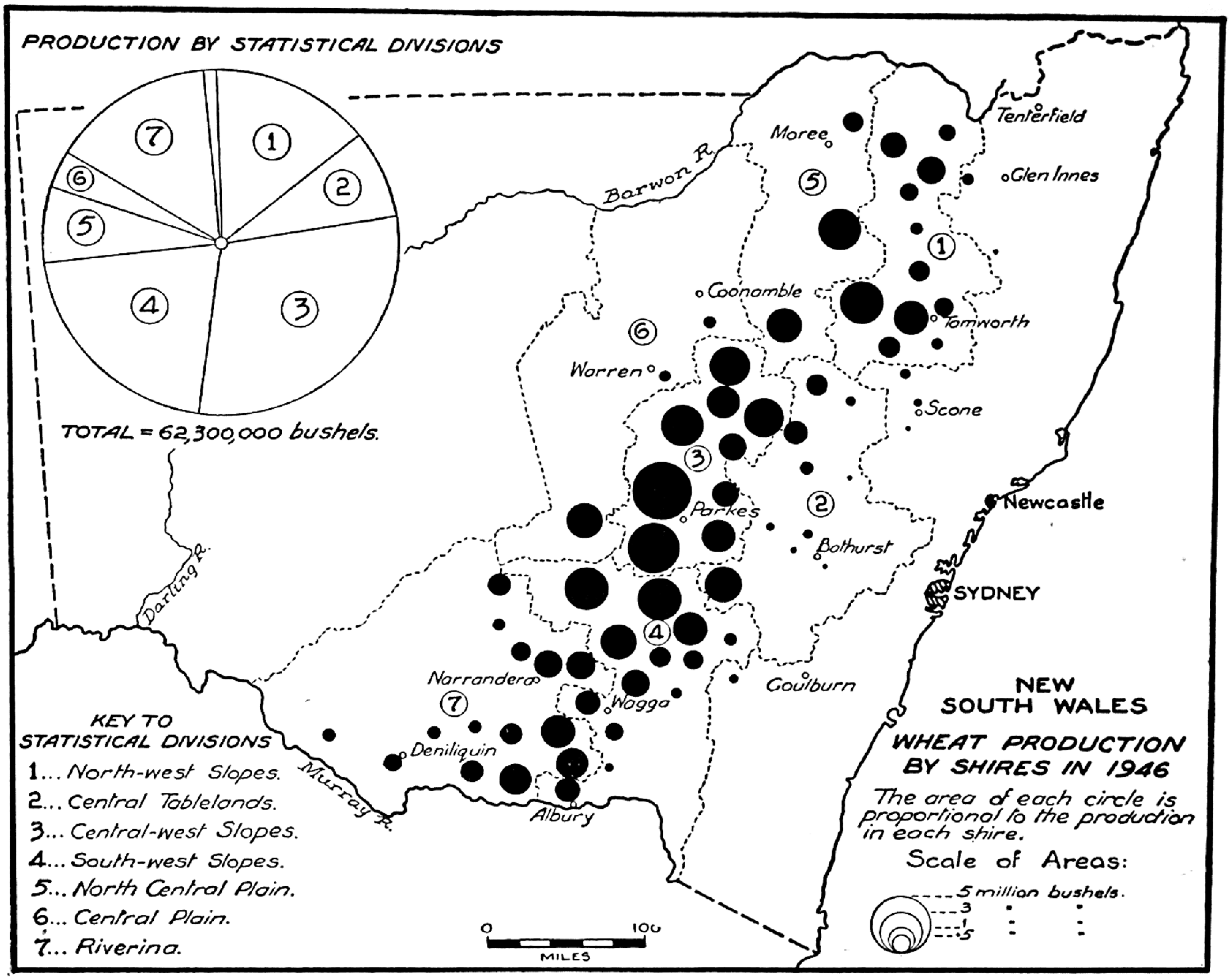

FIG. 83. Wheat production by shires in New South Wales.

elements just across the South Australian border have demonstrated that this "desert land in a good rainfall region" can be converted into pasture land. The Victorian Government is now beginning similar treatment of the unoccupied lands of the west. These areas may become important for fat lambs and grain fodder crops.

Density distribution and production of wheat in New South Wales (Figures 82 and 83). 1. Landforms, soils, climate and certain economic factors keep the limits of the wheat belt clearly defined, e.g., the eastern boundary where topographic changes have marked influence, and the western edge where dry conditions are the main factor. There is a falling-off to the north and northwest of the State, where black soil conditions, a summer rainfall and liability to disease are not as favourable to wheat as are conditions in the south. Here the red-brown earths, good, reliable rains in winter, and sound farming over many years give the central west and Riverina outstanding acreage and production, e.g., note the shires about Parkes, Grenfell and Temora. The only comparable area in the north lies about Tamworth, with its favourable soils and climate. Taking the State as a whole, it is well worth noting the relative productions of the statistical divisions as shown on Figure 83.

2. In recent years there has been some variation in wheat figures because of a boom in wool. In what is virtually a wool-wheat economy there has been a tendency to turn land from grain-farming to the more profitable raising of sheep.

Wheat silos in New South Wales and Victoria (Figures 84 and 85). To gain a fuller understanding of these maps, it is advisable that the keys of both be noted, especially to see the various types of storage available in the bulk handling of wheat. Further, Figures 84 and 85 must be related to such others of the series as Figures 81, 82 and 83, from which it can be seen that the higher density and yields would obviously mean more storage by silos, e.g., in the Riverina (New South Wales) and the Wimmera (Victoria), than where acreage was lower and production small, as in the eastern areas of Victoria and the northern districts of New South Wales.

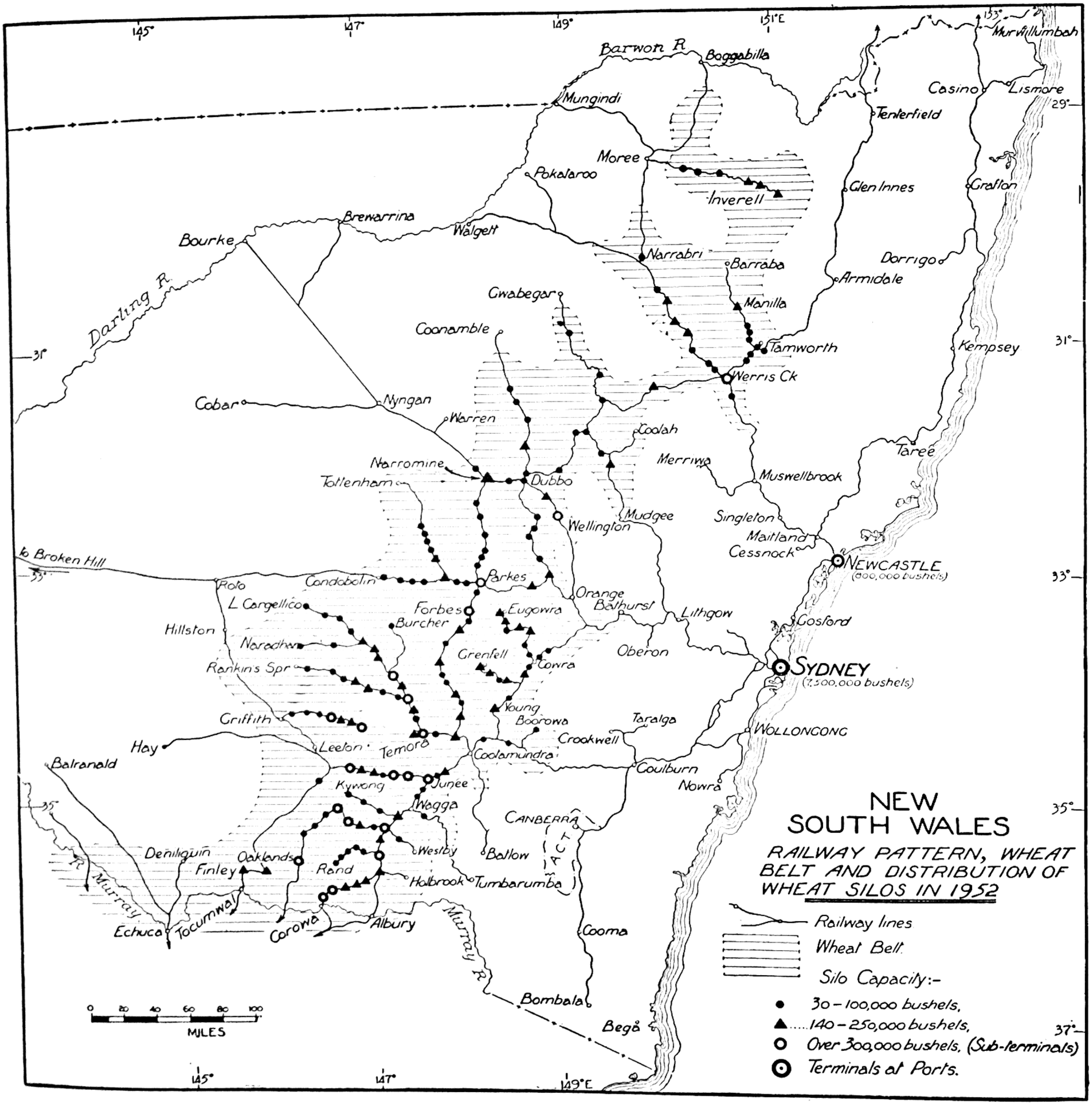

FIG. 84. The wheat-belt, wheat silos and railway pattern in New South Wales.

Relationship to rail patterns is also important. An interesting contrast can be made between the tentacle and network systems of the two States mentioned above.

The handling of wheat by silos has several features in its favour and is highly developed in the great commercial grain-farming regions of the world.

1. It is a labour-saving means of handling large amounts of grain.

2. There is speed of shifting, since it is possible to load a train quickly.

3. Costs of bags and bagging are saved, especially when the former are dear (being made of imported

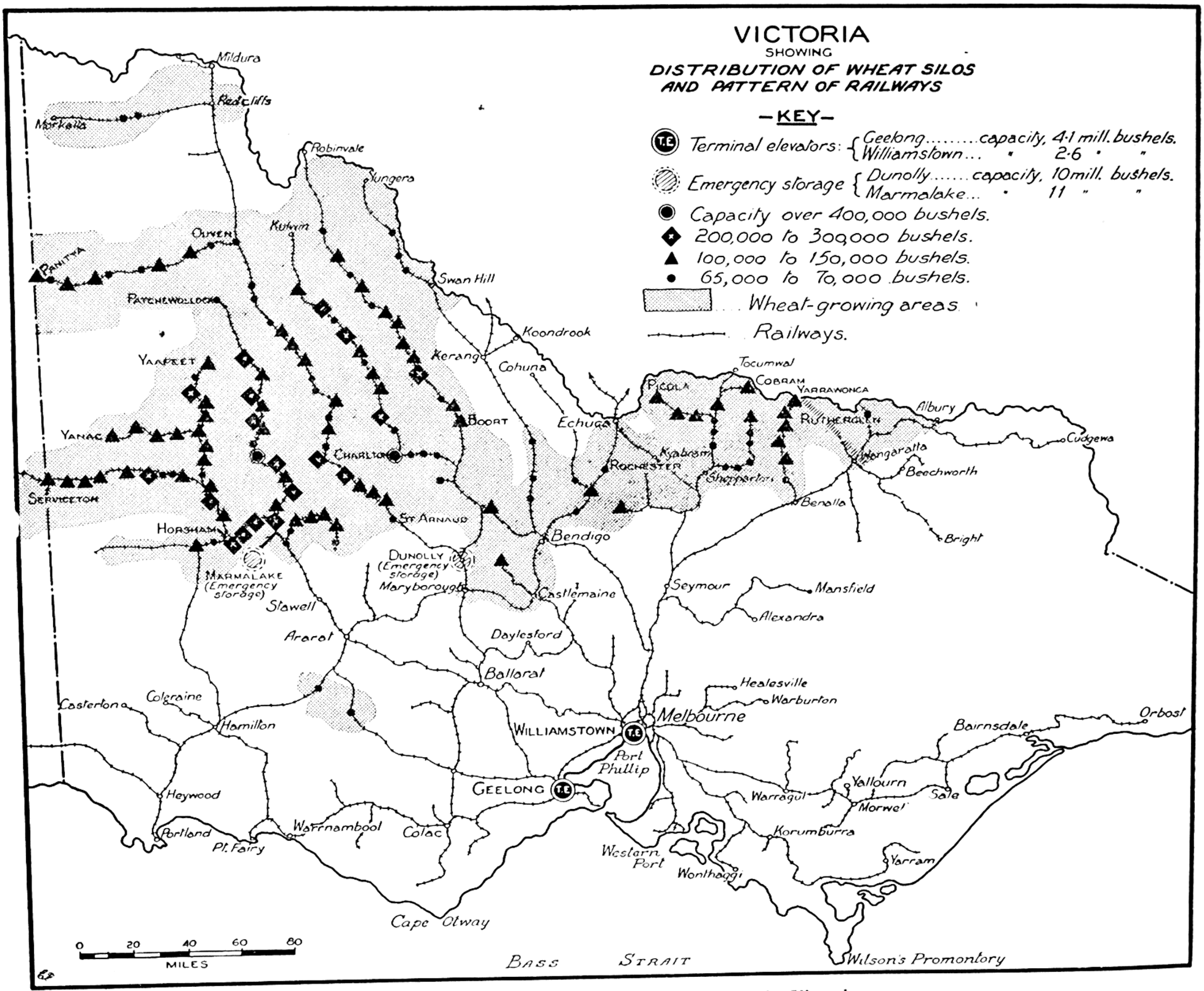

FIG. 85. Wheat silos and railway pattern in Victoria.

Indian jute) and the labour costs of the latter are high.

4. There is an effective storage of grain, since it is protected from the weather and vermin, as against being in stacks and only partly sheltered.

5. The movement of grain from silo to silo in the various stages of its transport keeps it in good condition.

In the actual collection and storage it must be remembered that it is a marked seasonal activity in which the different stages involve:

(*a*) Handling at single and small groups of silos scattered throughout the belt. Very few Australian farmers have their own silos on the property itself as in the United States. Further, primary handling still involves much bagging, although in America it has been largely abandoned in favour of motor-trucks carrying wheat in bulk from large grain boxes fitted on the harvesting combines.

(*b*) Transfer to subterminals (called emergency silos in Victoria), at strategic points where a big crop might be held for some time.

(*c*) Final movement to the largest holding points of all, the terminal depots at exporting points like the capital cities.

Flour-mills in New South Wales and Victoria (Figures 86 and 87). Flour-milling is a highly skilled process requiring expensive building, equipment and transport. It also needs a strategic placement of the mills in order to treat wheat and supply flour and other by-products to local and oversea markets. Considered in relation to other maps of the series, Figures 86

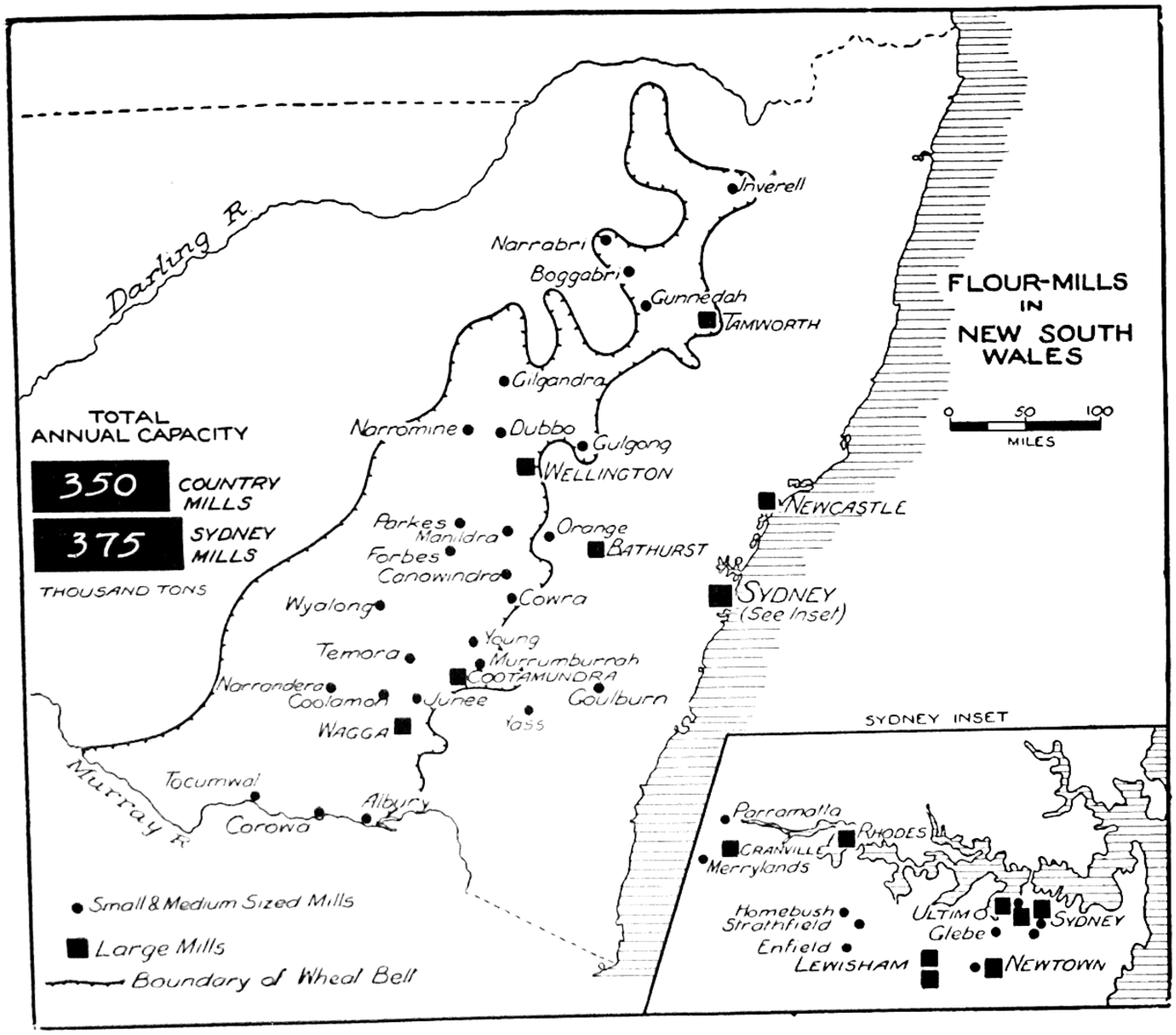

FIG. 86. Distribution of flour-mills in New South Wales.

FIG. 87. Distribution of flour-mills in Victoria.

and 87 help towards an understanding of this geographical aspect of the wheat industry.

1. Mills are located at strategic points throughout the belt. They also have their own silos, some of which are very big.

2. Much of the flour they produce is used locally (approximately one-fifth) and this accounts in part for the many small mills, some actually outside the wheat belt.

3. In the cities (see inset of Sydney mills, Figure 86), the mills manufacture for the immediate large urban markets. By-products like bran and pollard are in demand by poultry farmers who operate in the rural-urban fringe (see *Regions and Men*). At the same time such mills export overseas. Before World War II Australia was the world's major exporter of flour

4. All mills, both city and country, are close to railway lines. Some have their own branch lines. This is because of the bulk nature of the raw materials they handle.

5. In the over-all picture of the wheat belt, the mills reflect the contrasts in production and yield of the various districts of the States.

Utilization of wheat supplies in Australia, 1933-46 (Figure 88). From this diagram it is possible to see how Australian wheat is finally disposed of. In making a simple analysis of it attention is drawn to the axes of the graph showing the years (bottom) and the millions of bushel production (left side). The "production plus opening stocks" line at the top indicates the total available supplies biannually. The "closing stocks" represent the carry-over each year: they become the "opening stocks" for the following year. The following points are worth noting:

1. Closing stocks were highest during the war years, when exports were restricted for most of that period.

2. The falling-off in oversea trade in the early forties is clearly evident with a slight improvement later. Prior to this, especially in the early thirties, exports were large.

3. Wheat figures a good deal in Australian home consumption. A few by-products, other than flour, are now available.

4. Wheat as a stock feed came into prominence during the war, when farmers were encouraged to absorb the large stocks held.

5. Seed wheat supplies would appear to remain fairly stable. Such slight variations as appear here represent a dependence upon the acreage to be planted in each following season.

Since these figures were available there has been something of a change in the over-all picture of wheat production, with farmers decreasing acreage

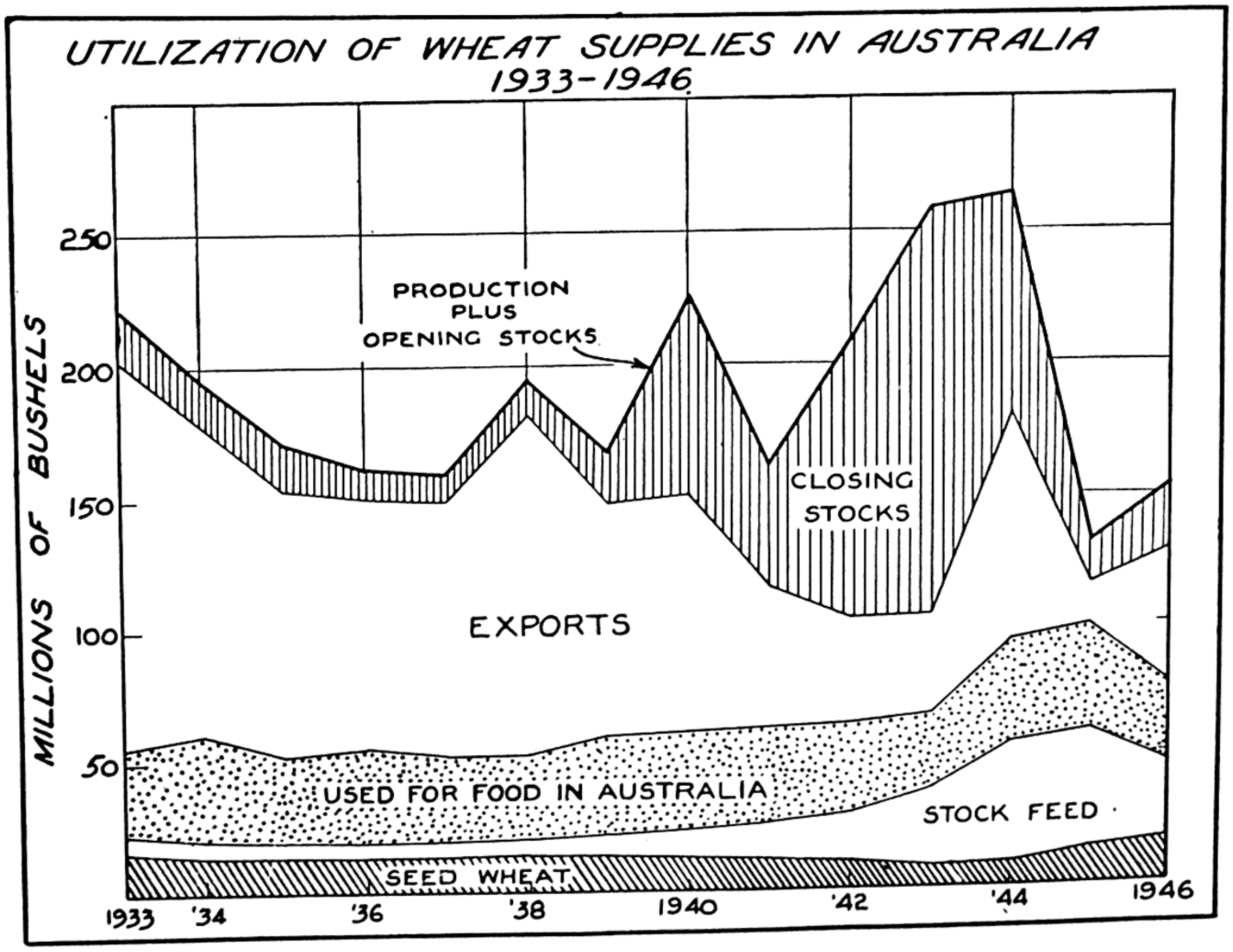

Fig. 88. Utilization of wheat supplies in Australia, 1933-46.

for a number of reasons (see notations on Figure 79). A situation has been reached where there are strong possibilities of Australia actually having to import grain to meet local demands and so lose large oversea markets.

Typical small farm in the wool-wheat belt of New South Wales (Figure 89). This property of some 330 acres is a typical urban-fringe farm situated a mile south of Wagga, in the Riverina. In the land use shown on the map the following points are important:

1. **Livestock.** The main activity on the property is the raising of fat lambs, with wool-growing as a lucrative subsidiary. Hence the large proportion of the acreage indicated as pasturage and grazing. Normally the farm carries 500 cross-bred sheep, which are shorn in late September. Grazing of sheep on the early wheat is a common practice in years of high rainfall, when rapid stalk growth may weaken the stand if not checked.

2. **Crops.** During the 1951 season, when the property was under observation, 30 acres of wheat and 30 acres of oats were sown on the sites indicated. The wheat was harvested as grain, some being used partly as poultry feed on the farm, some being kept as seed for the following year and the surplus sold. The oats crop was cut as hay and stacked on the farm to serve as early winter fodder for horses, sheep and dairy cattle. It is usual to build two stacks each year for this purpose.

3. **Rotation.** To reduce the incidence of skeleton weed, a serious pest in these parts, and to maintain soil fertility, rotation has been found essential. A typical rotation is wheat-oats-grazing-fallow on a four-year cycle.

4. **General.** Poultry and a few dairy cattle are kept, mainly to support household requirements. Note the location of the main buildings and the presence of the dam to offset dry spells in summer months.

The wool-wheat belt of New South Wales. Reference has already been made to the important livestock and crop associations of the wheat belt of New South Wales, but some further detail is necessary for a proper appreciation of its geographical significance.

1. **Location and physical factors.** The practice of raising sheep on nearly all wheat farms in New South Wales causes the wool-wheat belt boundaries to correspond with those of the wheat belt.

(*a*) On the east the belt is limited by rugged highlands, a 30-inch annual rainfall and podsolized soils.

(*b*) On the west the boundary is reached where wheat can still be grown successfully. Beyond it wool production is dominant.

(*c*) The topography of the belt varies from the forested hill and cultivated valley lands of the eastern parts to the extensive plains with residual hills to the west.

(*d*) The soils range over four major types: (*i*) the

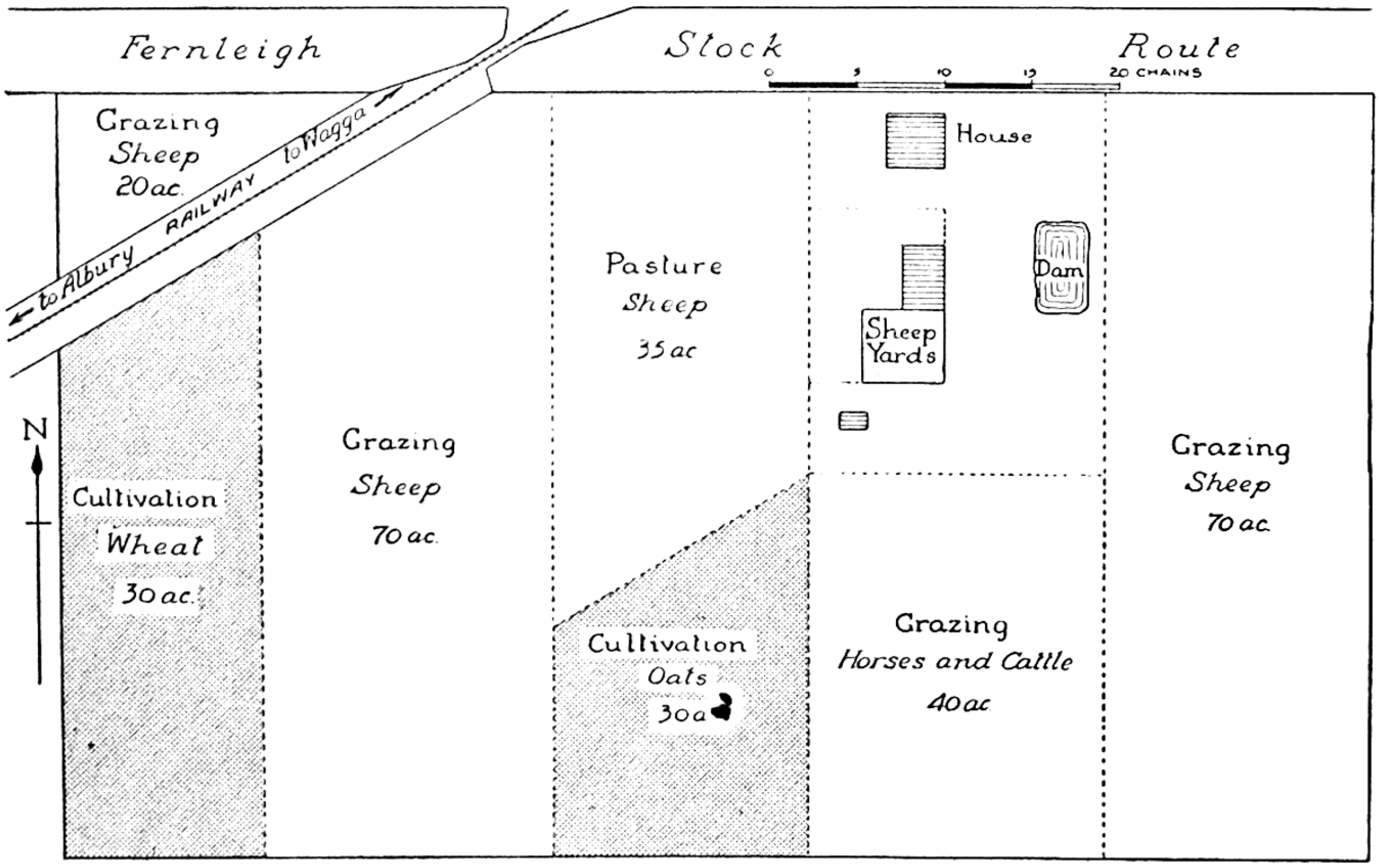

FIG. 89. Plan to show land utilization on a typical farm in the wool-wheat belt near Wagga.

heavy but fertile clays of the black earths to the north as about Inverell; (*ii*) the friable brown mallees of the western margins; (*iii*) the heavy-textured grey and brown earths also on the western limits such as the Darling River country and suitable to pastures; (*iv*) the rich, red-brown earths typical of the best wheatlands of the Riverina and central west.

2. Features of the farming. (*a*) The wool-wheat belt represents a region where, over a period of years, there has been a marked change from the sole objective of commercial grain-farming to one of livestock (sheep, pigs and dairy cattle) and crop (grain and some fodders) farming. This has been due to a number of factors, the most important being the inadequacy of small farms, forcing an extension of cultivation, and the recognition of fallowing as an essential practice. To-day, as a result of long adjustment to soil, climate and economic circumstances, there are very few farms without any form of animal husbandry. Fodders are not grown to any great extent but are provided on the weeds of fallow lands, wheat stubble and land unsuitable for cultivation.

(*b*) There are still holdings within the belt devoted solely to sheep-raising. The kinds of sheep vary with the locality and the objectives of the different farmers. Wool breeds appear in more western areas, mutton and fat-lamb breeds on the richer grasses of the moister east.

3. Associated Activities. Farm routine and the external service activities of transport and trade within adjacent urban settlements are similar to those mentioned in connection with the wheat belt.

4. Contrasts with the corn belt of the United States. The lower rainfall and the smaller return per acre from wheat are responsible, in a large measure, for larger farms in New South Wales. Wheat is the main cash crop, although wool and wheat are important commercial products. There is little growth of fodder crops, especially for sheep, in the manner in which corn is grown for cattle and pigs in the United States. Labour needs in New South Wales are more markedly seasonal because of the harvesting and shearing, and the population is more scattered than in the intensive farming of the American region.

COMMERCIAL GRAIN-FARMING IN NORTH AMERICA

Wheat-farming in North America is an excellent example of modern commercial grain-farming since it is individualistic, on a large scale (the average farm is 640 acres or more), and highly mechanized (see Figure 95). As a result of these and other factors, e.g., transport (Figure 92), the wheat belts of the United States and Canada constitute the largest and most important grain-producing region in the world. To appreciate the geographical background of this, study Figures 90 and 91 together. Also refer to other maps of the series devoted to North American agriculture. It is possible by this means to see that the major wheatlands of the continent occupy the prairies and steppe grasslands between the well-watered Middle West areas of mixed farming (Figure 95) and the drier mountain grazing lands (Figure 57). Their northern limit is determined by the shortness of growing seasons and their western boundary coincides with the limit of safe agriculture as the dry regions are approached (Figure 91). It is here that dry farming has created the "Dust Bowl" areas. Their southern limit is fixed roughly by the approach to tropical conditions and the appearance of cotton as the major crop (Figures 91, 117 and 118). The eastern boundaries are tied up with the soil and land use changes indicated in Figure 91.

To take full advantage of the maps, we shall deal with the various belts separately, noting the main features of each and their particular agricultural significance in the farm economy of North America.

The spring wheat belt. The spring wheat belt of Canada and northern United States is so called because

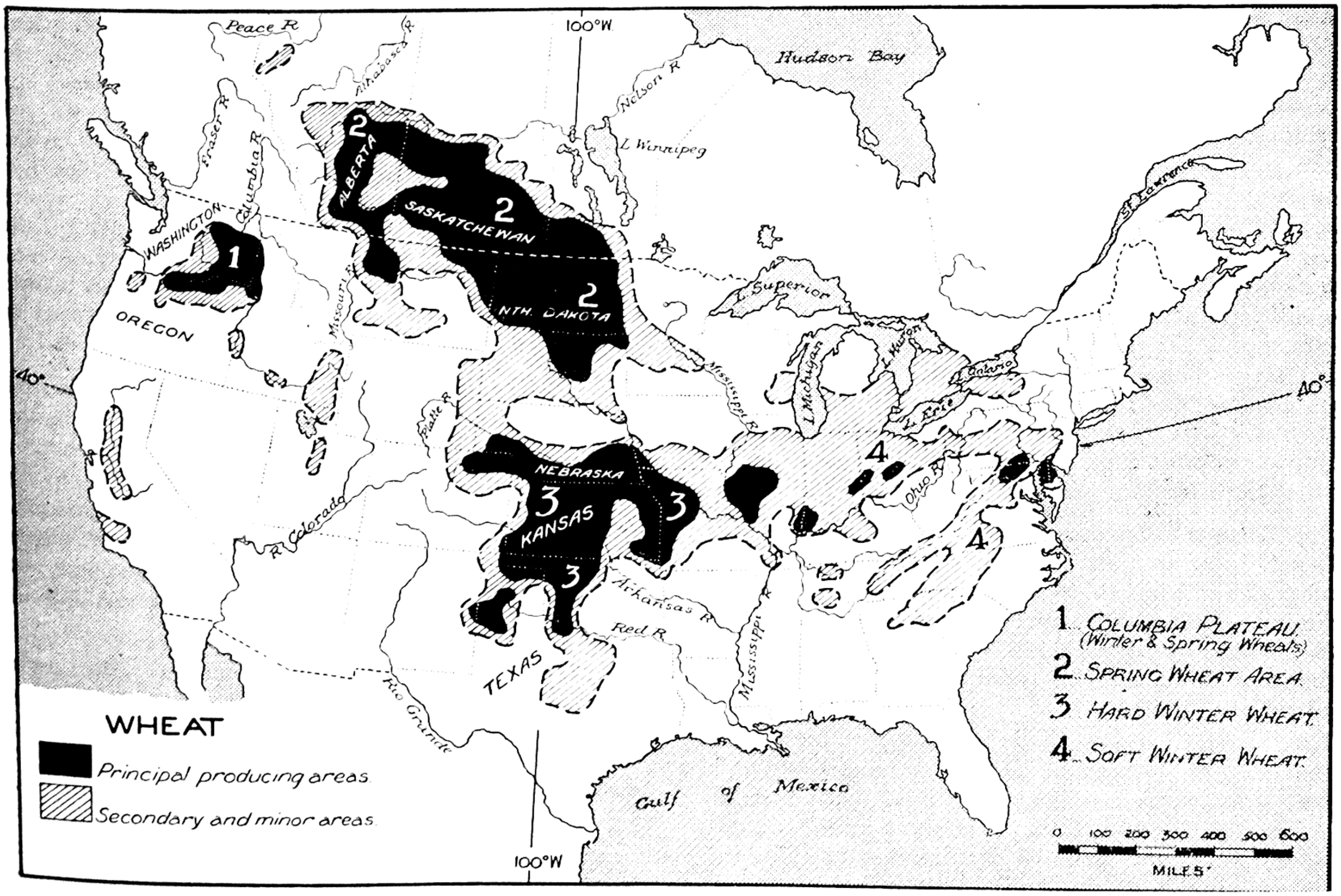

FIG. 90. General distribution of wheatlands in the United States and Canada (*After Whitbeck and Finch and Department of Agriculture, U.S.A.*).

the crop there is planted in the spring and harvested in the late summer or early fall. The main geographical features are:

1. **Location and landforms.** The region lies in a belt reaching from northern Nebraska through the Dakotas and part of Montana into western Manitoba, Saskatchewan and Alberta. Even farther north there is an area about the Peace River district, where special frost-resisting wheats have been developed. All of it is flat to undulating prairies, ranging from the level glacial floors of the Red River district to the rougher dissected foothills of the Rockies.

2. **Soils.** These are deep and fertile throughout, but require fertilizers to maintain production over the years. Both these and the landforms above facilitate the use of tractors, harvesters and other farming machinery.

3. **Climate.** There is a variation in climate from semi-arid to extremely humid types. Such differences in temperature and precipitation occur that they have a marked effect on the length of the growing seasons in various parts of the belt.

(*a*) Temperature conditions have a great seasonal range, from below freezing point in winter to over 60°F. average in summer and are closely associated with a 90 to 100 days growing period in Canada, 120 days' in Montana, and 140 days' in South Dakota. Long days of up to 18 hours of sunlight and the use of quick-maturing grains make up for the very short seasons.

(*b*) Precipitation is in the form of rain and snow. With the former as little as 13-15 inches per annum may fall on the drier marginal lands of the west, but up to 30 inches in the Minnesota districts. Almost half may fall in three summer months, but semi-arid conditions are offset by low evaporation and dry farming, a practice which proved disastrous in past years (see below). Snowfalls may not be significant unless associated with warm spells, the melting snow then provides extra moisture for the spring germination; or severe frosts, which affect soils to a considerable depth for long periods.

4. **Farm routine and economy.** (*a*) As the ground is frozen in winter all planting is done in the spring after the soil has thawed out. This is a rush period, since ploughing and planting must be done as quickly as possible owing to the short growing period. Germination must also be rapid, or the crop will not ripen by autumn.

(*b*) Harvesting usually takes place in July in Canada and in July and August in the United States. The harvest season is the busiest time of the year, for the crop must be gathered in the short period between ripening and the onset of the first winter rains and snows. Because of this both combine harvesters and reapers are used and considerable hired help employed.

(*c*) When cropped with a combine harvester the grain is transported direct to the railhead for shipment. When cut with a reaper the wheat is stooked till dry and then threshed with a machine. Most farmers who use the latter method of harvesting hire a man with a complete outfit and a team of employees who work it. These travel from farm to farm during the season and are paid contract rates. Using up to ten machines at once, it takes only a few days to strip a crop if the weather is fine.

(*d*) Shortly after it is harvested and threshed the wheat is sold for distribution to milling centres and the various markets. In recent years many farmers are adopting the practice of building their own silos in which to hold grain until transport by rail is available or the prices are suitable. The continental movement of the spring wheat crop is best seen by referring to Figure 92.

(*e*) As well as wheat, several supplementary and rotational crops are grown (Figure 95). Thus oats, barley and rye, with maize in the southern section of the United States, are used to provide fodder for the draught horses and for the cattle, pigs and fowls which furnish food for the farmer. Flax is an important supplementary cash crop and is grown both for seed (linseed) and fibre (linen). Hay (clover and alfalfa as well as natural prairie grasses) is cut and stored in large barns for winter stock fodder. Finally, the farmer grows all his vegetables, and potatoes are especially important. All these field crops are cultivated in a rotation system which tends to lessen the dominance of wheat and to maintain soil fertility. This significant diversification is a more recent tendency which arose out of the disasters of the thirties, when crops failed and erosion became rampant due to intensive one-crop farming for years before. This might well be compared with developments in the cotton belt.

5. **Special features.** (*a*) The serious effects of soil erosion by wind which followed dry farming in the marginal lands of the west, i.e. the method whereby a crop is sown one year and the land left fallow (with occasional light cultivation) for the following summer season. Many acres were destroyed completely, others returned to limited grazing, and some were conserved by strip and terrace measures and new methods of ploughing.

(*b*) The special hazards which face the grain farmer, including those of climate and weather changes, e.g., low rain, hailstorms and late frosts; diseases and pests, e.g., rust and grasshopper plagues; and the financial loss due to grain price fluctuation.

(*c*) The great advances made in research to evolve new wheat types (adapted to climatic demands) and new varieties of wheat to produce flour of better milling quality.

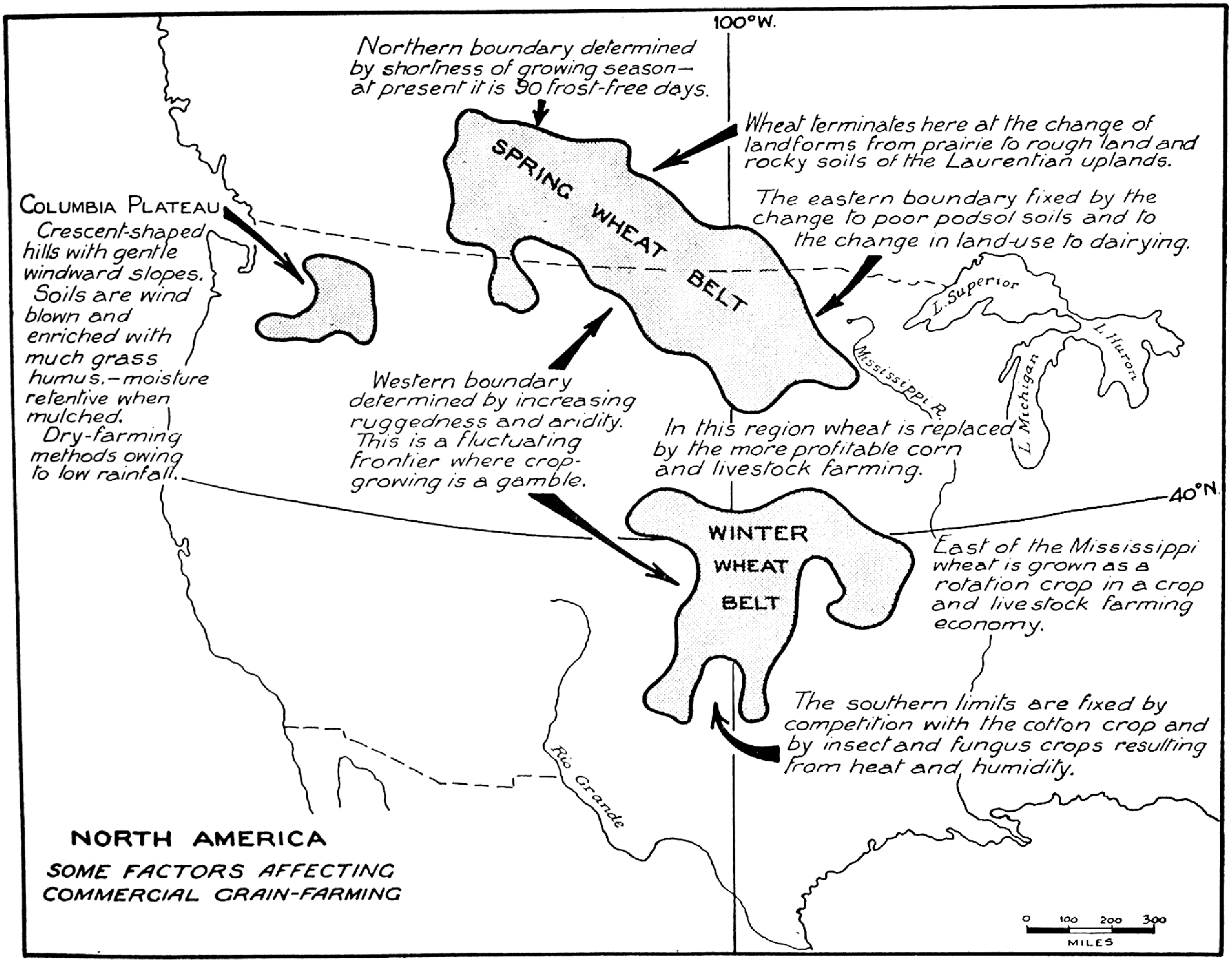

FIG. 91. Map summary of some factors affecting the location of commercial grain-farming for wheat in North America.

(*d*) The change-over to dairying in the east of the United States, where it is being found more profitable.

Hard winter wheat. This type of grain is planted in the autumn, stops growing in the winter months but develops quickly in the following spring. Harvesting is carried out in June and July.

1. Location and geographic factors. Hard winter wheat is grown mainly in Kansas, Missouri, Oklahoma and north Texas. In this belt the rainfall is between 20 inches and 30 inches per year and temperatures are high in summer, rising as high as 121°F. in parts of Kansas. The main feature of the climate is the great variability in rainfall—up to 20 per cent—which can cause droughts, hot winds and erosion. As in the spring wheat region the land is flat to rolling and the soils very fertile. The growing period is from 150 to 200 days, so that slower maturing types of grain may be used by the farmers.

2. Supplementary crops. Although there is much the same routine and mechanization here as in belts to the north, farms are smaller, there is less rotation and crop diversification is limited by the conditions, e.g., oats and rye do not appear. On the other hand there is a concentration on fodder crops like alfalfa, maize (mostly in the east) and grain sorghum (in the south). This is because most farmers keep beef cattle, making the belt one of the chief producers of the country. Grain sorghum is a multi-use crop since it stands up to drought, can be used as a binder plant in soil conservation, and is grown as windbreaks which are an important and common feature here. In the mechanization combine harvesters are employed mainly to gather the crop from which the production is usually a lot greater than in the Columbia region (see below) and in Australia but much less than in the spring belt.

Columbia Plateau region. Embracing both the States of Washington and Oregon, the Columbia Plateau has

a varied topography, but the main wheatlands are located in basins and rolling hills. Here the soils are largely of loess formation, derived from past volcanic activity, and easily eroded. Since one-crop farming has dominated the scene for many years, the wheat acreage is declining. This is in spite of an almost universal dry farming adapted to a rainfall as low as 10 inches per year and the use of contour ploughing. Rotation of crops is increasing and includes alfalfa and clover. Most of the properties are large, i.e. over 300 acres, and machinery is important, the more so since labour is a problem in a relatively small population.

Both winter and spring wheats are cultivated for export, since in this particular region they have developed a starchy character. The amounts which do reach local markets are absorbed by the biscuit and pastry trades.

Soft winter wheat. Large quantities, i.e., an average of some 180 million bushels annually, of soft winter wheat are grown in the north-eastern States of the United States. Here the wheat is used largely as grain fodder for poultry and dairy cattle. It is also mixed with the hard western wheats for milling purposes in local mills and none is exported overseas.

The cultural landscape. The cultural landscape of the American wheatlands is not unlike that of other regions (e.g., the Australian wheat belt), where this type of commercial grain-farming has developed. Thus the over-all scenery is one of a patchwork of large fields with homesteads widely spaced and being served by radial roads to the railheads of small service towns and villages. On the farmsteads, buildings include both the homes of owners and quarters for the casual employees engaged at planting and harvest times. There are also large granaries where the grain is stored whilst awaiting shipment. The larger settlements have the characteristic silos and rail yards for wheat storage, trucking of stock and handling of various farming supplies, like machinery, wire and fertilizers. Other buildings are devoted to servicing requirements for the district, i.e., shops, banks, schools and especially garages, needed for the large motor transport involved in such districts. A detailed example of the over-all transport and settlement pattern is given in Figure 93 dealing with the region of North Dakota.

Approximate routes of wheat movement in North America. In studying this map (Figure 92) careful

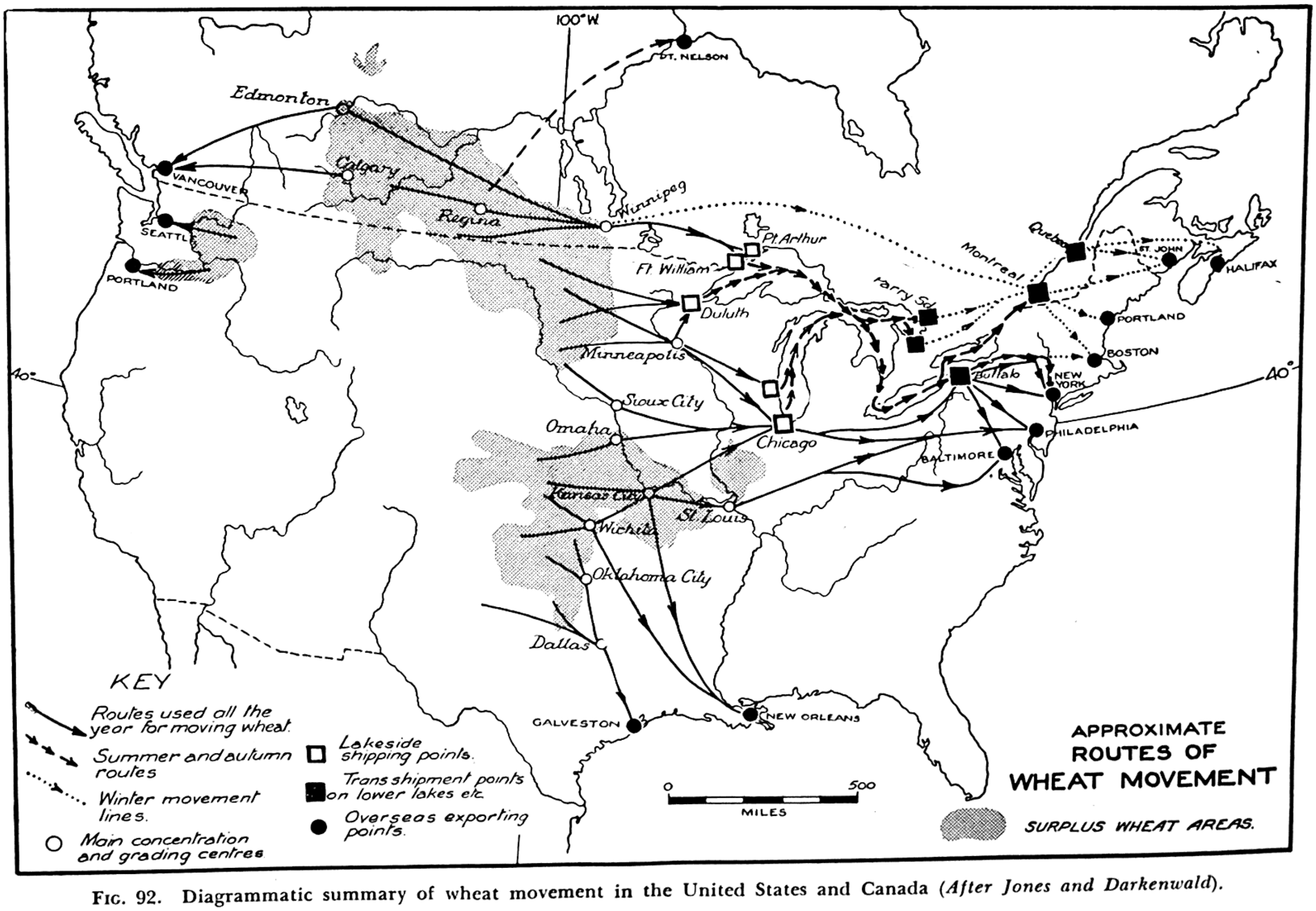

FIG. 92. Diagrammatic summary of wheat movement in the United States and Canada (*After Jones and Darkenwald*).

attention should be given to the key showing the various symbols used. Certain features emerge.

1. A big area has surplus wheat supplies. Some wheat is kept in these growing regions for local flour supplies, seed wheat and animal fodder, but large amounts are shipped to the industrial north-east and the non-wheat-producing parts.

2. In both Canada and the United States all wheat is handled in bulk, whether on road, rail or water. Transport by ship is cheaper than by rail and there is a special significance attached to the Great Lakes and the St Lawrence River in the lifting of both the spring and winter wheat crops, although there are seasonal restrictions of movement. Rail rates are lower in Canada than in the United States because of Canadian government subsidies.

3. The harvests for export are usually moved in the first place by trucks from the fields to country elevators or silos at railroad sidings. From here the grain goes to certain concentration centres, e.g., Regina and Wichita, where it is graded for local use, or national or oversea export. Pending this work and whilst awaiting trans-shipment the wheat is held in elevators, e.g., in Minneapolis, which holds the bulk of the United States spring wheat with some 70 silos having a total capacity of 94 million bushels.

4. The major transport routes from these centres are used during the whole year, especially in the southern part of the continent. But seasonal interruptions occur in the north, where severe winters affect both land and water movements of the grain. For this reason attention is directed to the strategic location of the shipping points (indicated by squares) where enormous storage facilities are needed.

5. Canada exports about 60 per cent to 70 per cent of its wheat crop overseas. To facilitate this the main lines of movement are:

(*a*) west to Vancouver and taking about 30 per cent of the exported grain;

(*b*) east through Port Arthur and Fort William, when the crop moves *via* the Great Lakes to either the St Lawrence Valley ports, e.g., Montreal, and the Maritime Provinces ports or through Buffalo to New York, Philadelphia and Baltimore;

(*c*) north through Port Nelson, a minor summer seasonal route only of short duration, when most wheat is being moved from the northern sections of the belt.

In the United States wheat is moved out of the country along the following routes:

(*a*) the crop of the northern areas and portion

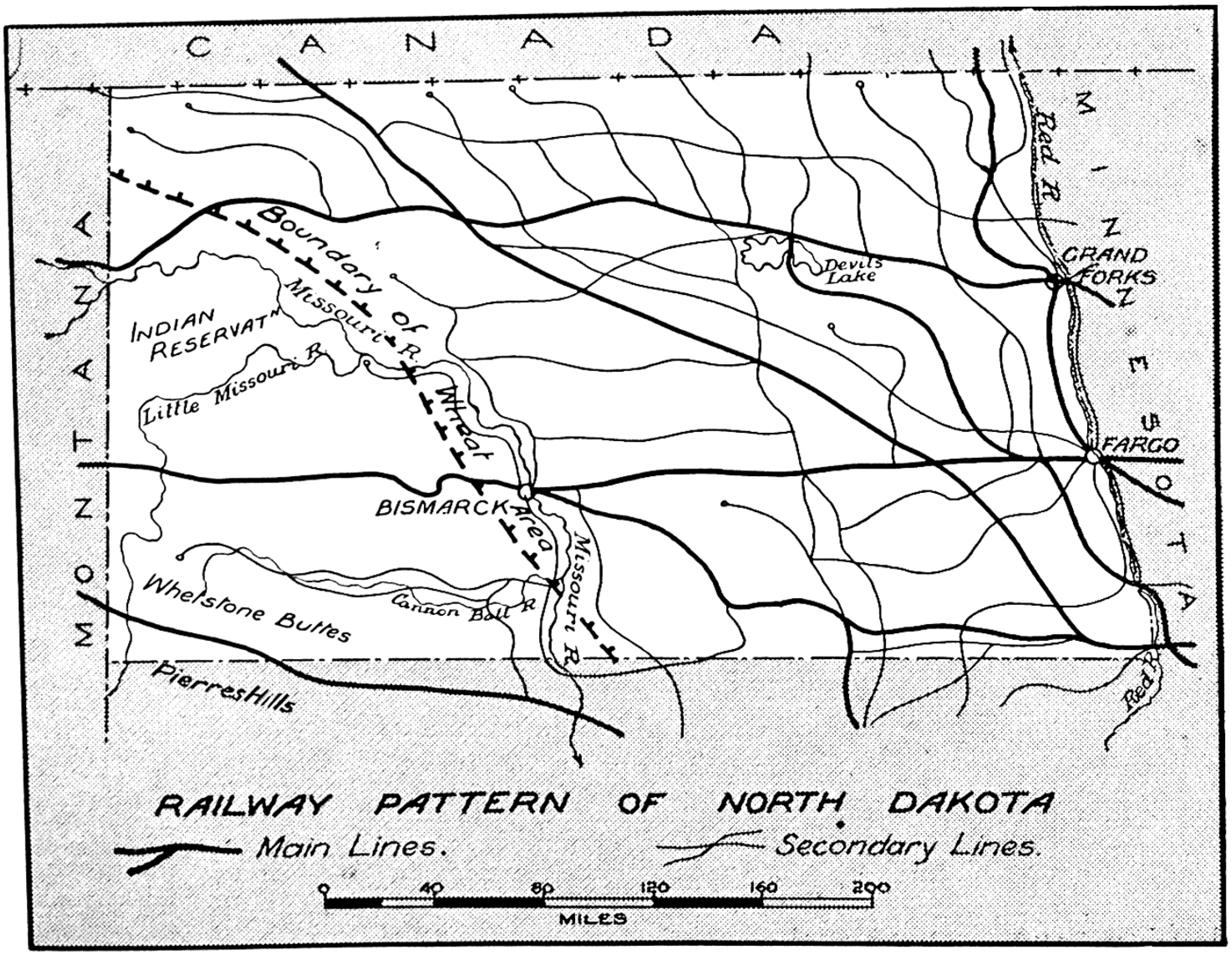

FIG. 93. The railway pattern of the wheatlands in North Dakota, United States

of Kansas move by rail to Chicago and Milwaukee, thence by water *via* the Great Lakes and the St Lawrence or through Buffalo to the tide-water ports of New York, Philadelphia and Baltimore;

(*b*) the hard winter wheats are largely transported south to the Gulf ports of Galveston and New Orleans;

(*c*) the grain of the Columbia Plateau is railed west to Seattle and Portland and may use the Panama Canal *en route* to Europe.

Railway pattern of North Dakota. Figure 93 is an example of how a railway transport pattern may develop in a region where the geographic circumstances of topography, soil and climate favour the extensive cultivation of a grain crop like wheat for commercial utilization. Here are the main reasons:

(*a*) A relatively close network of secondary lines must be built, since wheat-growing cannot be profitably carried on at more than 25 miles from a rail loading point.

(*b*) Where production may not be so great secondary tentacle lines reach out to terminal railheads, e.g., on the north and west of the area shown.

(*c*) The major corridor lines pass through to carry the grain away to the major markets.

All these lines, of course, are subject to heavy seasonal use, a practice which on a continental scale is demonstrated on the map showing the routes of wheat movement in North America.

Associated with this transport is a close pattern of small towns and villages. These have developed in response to demands for the maintenance of storage and transport facilities related to the movement of grain at certain specific points. They also provide service industries and social amenities to meet the daily needs of homes and farms in the immediate districts. Because of this it must be remembered that a large number of radial roads not shown on the map run from the rail centres. Other features to be noted on this particular map are:

(*a*) the larger settlements of Fargo and Grand Forks to the east—they are the major centres of the region—and other agricultural activities, e.g., potato growing, irrigated sugar beet and turkey raising;

(*b*) the restriction of cropland, cultivation, settlement and transport pattern to the west by the foothills and rugged country adjacent to the Rockies of Montana.

LIVESTOCK AND CROP FARMING IN THE CORN BELT OF THE UNITED STATES

This form of agriculture is one where both animals and crops are produced on the same farm. It is a mixed farming economy and in the true example of it the farmer grows crops (both grain and fodder) to feed to his animals. He then sells the animal or animal product to obtain his income.

Examples of this pure type of livestock and crop farming may be found in: (*a*) the corn belt of the United States, where pigs, beef cattle and poultry are the principal end-products; (*b*) the dairying districts of Holland, Denmark, Britain, Germany and the United States, where milk and milk processed products are sold; (*c*) the Pampas of Argentina, where prize beef is produced.

For convenience several other farming types are included under this heading. Examples are: (*a*) the wool-wheat belt of New South Wales (in fact all of the wheat-growing areas of Australia), where both animal products in the form of wool and fat lambs and the wheat are sold; (*b*) the dairying districts of New South Wales, Queensland and Victoria, where the animal product is the article sold, but where year-long hand feeding on fodder crops and grains grown by the farmer is not commonly practised.

Corn distribution in the United States. 1. At first glance, this map (Figure 94) shows how with a few exceptions corn (maize) is grown widely throughout the United States in an area which measures about 1,200 miles from north to south and some 1,600 miles from east to west.

(*a*) The Mississippi basin is the major maize-producing region with some extensions to the coastal plain in the east and the prairie lands of the far west and north-west.

(*b*) There are differences in production ranging from major to minor areas due to variations in topographic, climatic, soil and economic conditions. These are discussed more fully in other maps of the series devoted to this topic (see especially Figure 96).

(*c*) The most important area is known as the

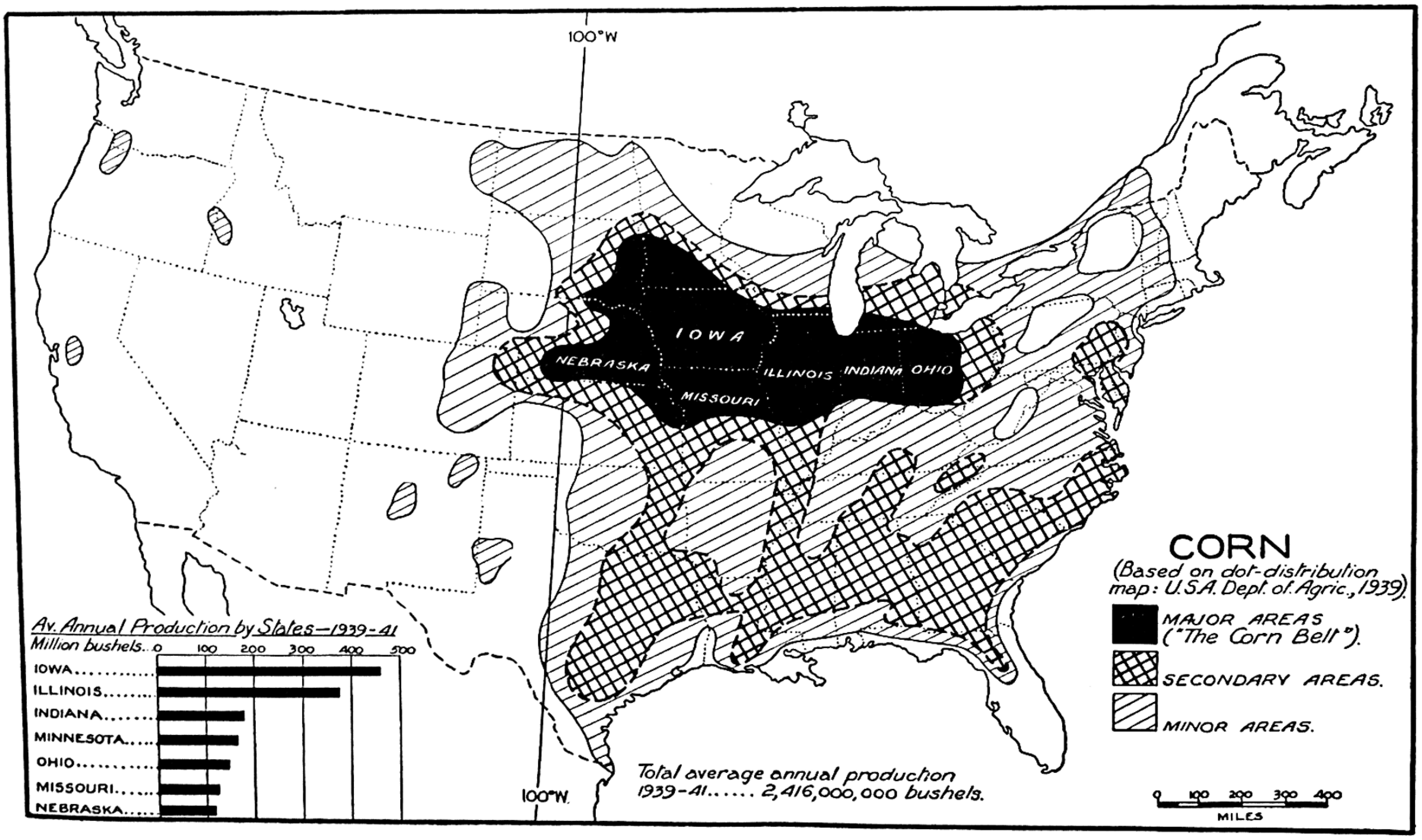

FIG. 94. The general distribution of corn in the United States (*After Department of Agriculture, U.S.A.*).

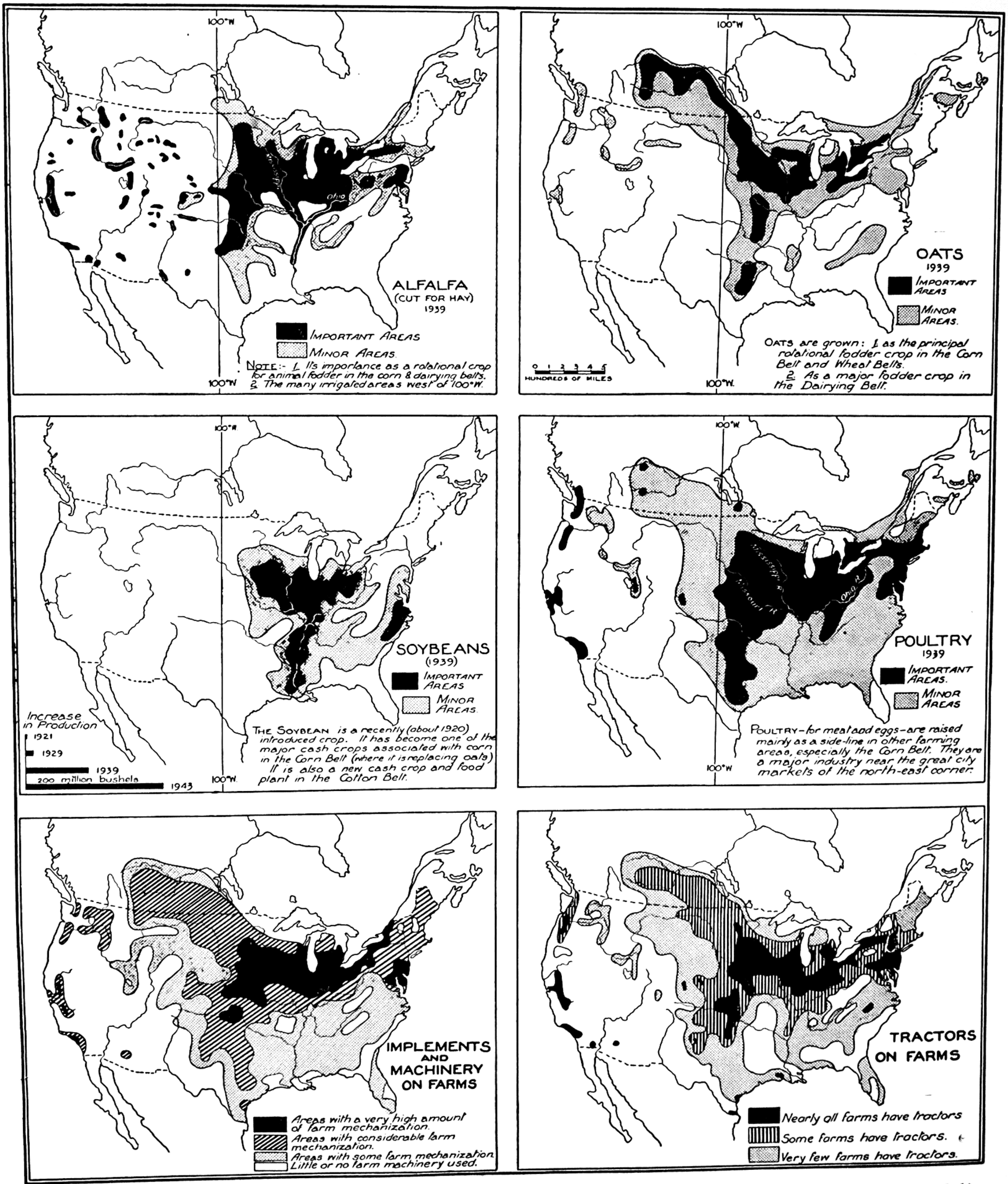

FIG. 95. Crops associated with corn and mechanization on farms in North America (*After Department of Agriculture, U.S.A.*).

"Corn Belt", which, running south of the Great Lakes, stretches west from central Ohio to central Nebraska. (It is a good exercise to find out all the States involved in this particular agriculture including those classed as secondary areas on the map.)

(*d*) The average annual production by the major States for the period 1939-41, included as a bar graph, reveals that Iowa and Illinois have the highest production, with an average of about 400 million bushels each.

2. In spite of the high output of one cereal in these regions, nearly all the farms grow other crops in suitable rotation, e.g., wheat and oats, in association with a huge number of livestock, e.g., pigs, cattle and poultry. As one moves out from the actual belt itself to the secondary and minor areas, such agricultural activities may become equal to, if not more important than, the cultivation of corn. A special map gives details of some of these (see Figure 95) so that here it is sufficient to note the following:

(*a*) Beef cattle are most numerous in the central and western prairie lands, where pastures are more abundant (see Figure 56).

(*b*) Pigs are found throughout the whole belt with special concentrations in the western portion (Iowa, Illinois and Nebraska), where corn is cheaper and can only reach the market in the form of meat.

(*c*) Poultry, both for eggs and meat ("chicken") are raised as a sideline on nearly all farms throughout the corn belt.

(*d*) In the cooler regions to the north and east dairy cattle become more numerous. Here the corn is often grown for green fodder rather than grain.

(*e*) Alfalfa (lucerne) is a very valuable hay plant grown in rotation with the corn. It grows best in those parts west of the Mississippi and about Lake Michigan.

(*f*) Soybeans with a multiplicity of food and industrial uses have become very important in states like Illinois and along the Mississippi.

(*g*) Both alfalfa and soybeans are legumes and are therefore important rotational crops helping to maintain soil fertility.

3. Apart from these details of distribution of maize and associated agriculture several features of special significance in the corn-growing areas in recent years are worth noting.

(*a*) Increasing mechanization by the use of small tractors, harvesting and other machines causes an increase in the size of farms but at the same time decreases the call for rural labour and leads to a considerable migration from rural areas.

(*b*) The occasional losses in topsoil and fertility due to over-cropping are being partly offset by introducing conservation methods and the education of farmers by a splendid agricultural service.

(*c*) Important contributions are being made by the experimental agricultural stations and colleges applying their scientific findings. As a result of these:

(*i*) Soybeans are being used more extensively to increase the fertility of the soil and to produce meal, hay, silage and pasturage.

(*ii*) Better strains of hybrid maize are being bred to increase yields.

(*iii*) Maize is being used for a wider variety of products, particularly oils, so as to meet the strong challenge of the imported tropical palm oils.

4. Arising out of the above almost purely agricultural aspects of the corn-growing regions there are geographical factors concerned mainly with the settlement pattern which has evolved here.

(*a*) There is a settlement pattern like that of the wheat areas, consisting of homesteads with farm buildings and many hamlets and towns at close intervals. The last-named are typical small trading or entrepôt centres in a rural setting with a close dependence upon the neighbouring farmlands.

(*b*) There are quite a few large cities which are focal centres for whole regions or States. In addition they usually have many and varied manufacturing activities of a type concerned with the processing of agricultural products and the supply of food, clothing, shelter, farming implements and such general luxuries as can be afforded by a well-to-do population.

(*c*) Some of the more important of these city centres are Chicago, St Louis, Cincinnati, Milwaukee, Indianapolis, Minneapolis, St Paul, Kansas City, Omaha, Sioux City and Des Moines. (A worthwhile exercise would be to work out what are the main industries to be found in each, more particularly those connected with the packing and refrigeration of meats, the tanning and making up of hides, the production of fertilizers, the manufacture of agricultural machinery and the processing of corn and other grains and plants for food and industrial by-products.)

(*d*) With an abundance of food, raw materials, coal and electric power and an excellent road and rail network, the corn belt has developed many manufacturing activities. In the eastern portion of the belt (Illinois, Indiana and Ohio) there is an overlap of the corn belt and the industrial region of north-eastern United States. Here are many metropolitan centres devoted to various phases of the steel industry as well as meat-packing, tanning and shoe-making, the making of corn products and the manufacture of agricultural machinery.

West of the Mississippi the industrial activities are more closely allied with the farming and mainly consist of making agricultural machinery, meat-packing

and the general processing of grains. Important centres here are Kansas City, St Louis, Omaha, Des Moines and St Joseph. Eastern industrial centres include Chicago, Peoria, Davenport, Springfield, Indianapolis, Toledo, Columbus, Cincinnati and Fort Wayne.

Geographic factors affecting the location of the corn belt (Figure 96). The corn belt contains the largest amount of land in the world having optimum conditions for the cultivation of corn. It is not devoted entirely to corn, but the economy of the farms revolves about the corn grown. Actually it is one of the most highly developed regions of livestock and crop farming in the world, with a close inter-relation between crops and animals giving great agricultural prosperity and high living standards. This is the outcome of an effective utilization over the years of land, crops, machinery and animals. This has been made possible because of fundamental geographic factors.

1. Landforms and soils. The topography is mainly of a gently rolling character with few hills giving way to areas of level plain. This landform character makes for easy cultivation of the productive soils, derived largely from past glacial action spreading deep layers of till (outwash soils deposited by streams along the front of the ice sheet) and from wind-deposited deep loess, especially in the western areas of the belt. Not only are such soils suitable for corn-growing, but they suffer very little leaching during the cold dry winters. The fertility of these soils is maintained in part by rotation cropping of corn, oats, wheat, alfalfa and hay.

2. Natural vegetation. In the past the eastern areas were covered with large stands of timber, while to the west were vast prairie grasslands. Most of this native vegetation cover has been removed with the spread of agriculture. The grass regions required almost no clearing by the pioneer farmers and richer soils were found there than in the forests. But the latter did provide valuable sources of timber for the settlers.

3. Climatic factors. Corn needs plenty of heat and sunshine allied with moisture. Within the corn belt

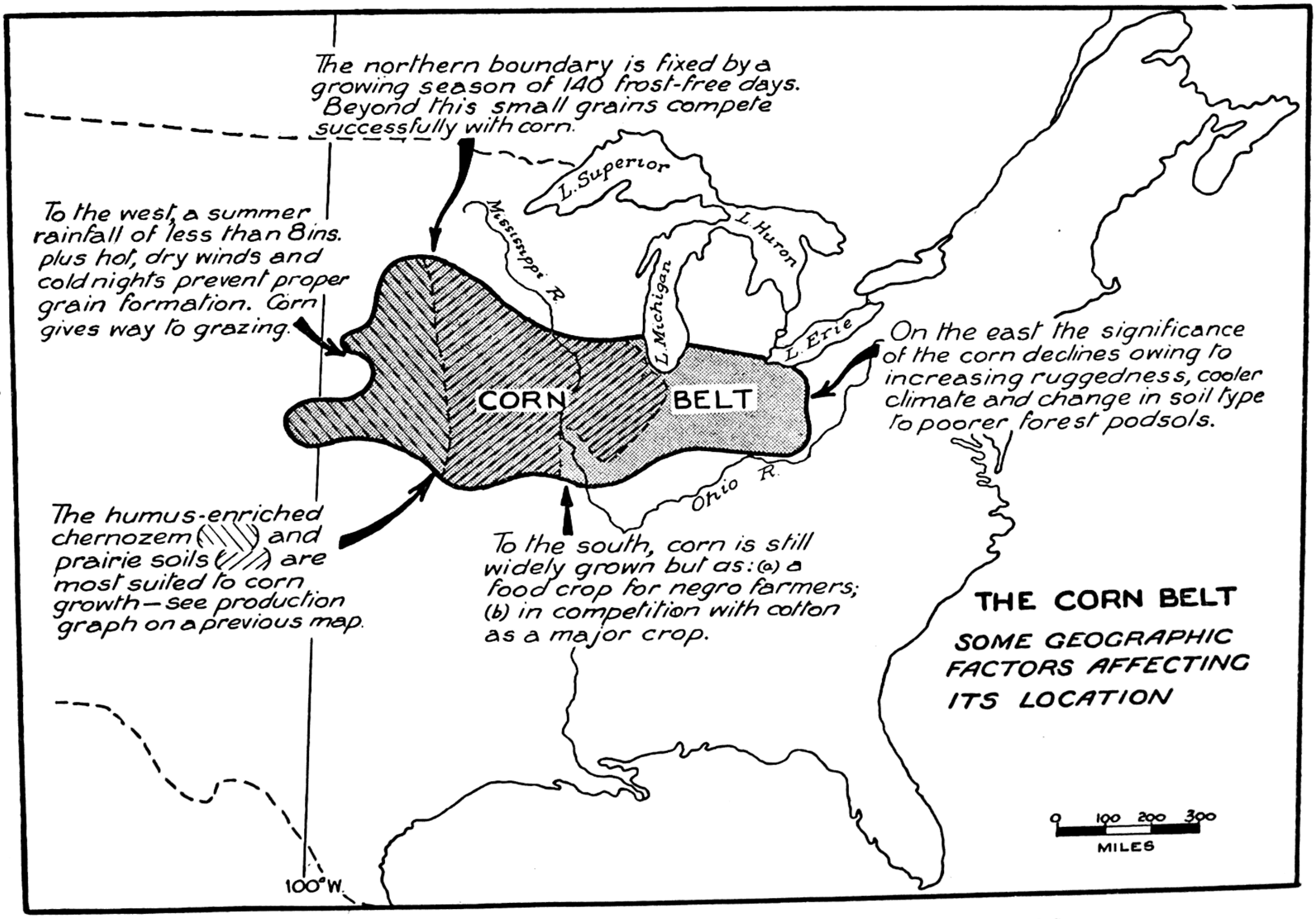

Fig. 96. Some geographic factors affecting the location of the corn belt in the United States.

rainfall varies between 20 inches (in the west) and 40 inches (in the east) falling mainly in early summer and spring. This gives a typical régime of warm sunny days and showers at night or in the late afternoon, producing plenty of hot humid weather. Maximum temperatures may reach 108°F. Such conditions do not interfere with the weekly cultivation of the corn, while the cool nights of the early autumn hasten the ripening of the crops.

The colder seasons with frosts set a limit of 140 days to the growing period in the north. In spite of severe winters with temperatures as low as −30°F., which freeze the soil, there is little leaching effect as already mentioned.

From the above it is now easier to appreciate on the map those factors which delimit the area of the corn belt.

(*a*) On the western boundary of the Great Plains a limit is fixed by rainfall, temperatures and wind conditions which do not favour corn but rather drought-resisting wheat, grain sorghums and beef cattle raising on the steppe grasses of the High Plains, e.g., western Nebraska.

(*b*) The northern boundary is determined by a stated frost-free growing period (140 days), together with the 70°F. summer isotherm. North of this the summer days are neither hot enough nor long enough for the ripening of corn for grain, although it is still used for green fodder. Here corn is allied to small grain crops, more especially those of the spring wheat sub-region.

(*c*) In the east the cornlands are limited by the more rugged topography of the Appalachians and the occurrence of poorer shale and sandstone types of soils. The belt merges into poorer general farming, dairying and cash crops for nearer urban markets.

(*d*) Towards the south corn is still grown widely, not as an important means of fattening cattle for market but as human food like corn meal, corn bread and hominy. The yield is lower because the rich glacial soils no longer occur except in Kansas, and there the hot south-west winds in summer affect the plants before they can mature. Higher temperatures also increase the danger of pest and fungus diseases, and the physical conditions favour cotton as the major commercial crop.

In addition to all the above geographic circumstances favouring the development of the corn belt where it is now, certain economic and cultural factors have been significant. The rise of this region cannot be separated from the growth of many large cities and their associated railway-road patterns.

Typical farm in the American corn belt. Figure 97 shows the subdivision of a typical farm in the corn belt which permits crop rotation. In this sketch the crops grown in any given year may be ascertained by reading across it. To see the sequence of the rotation, read down the column. Important features to note are:

(*a*) The usual rotation is corn followed by a cereal, then by a legume, then by pasture and finally back to corn.

(*b*) The use of legumes is particularly important in helping to maintain soil fertility and in providing an excellent fodder for both pigs and cattle. The soybean also supplements the farmer's income.

(*c*) When used, clover and alfalfa are planted at the same time as the cereal. The latter grows quickly and is harvested in the year of planting. The legume grows more slowly and is not utilized until the year following its planting. Such double planting saves labour and gives complete protection to the land for two years.

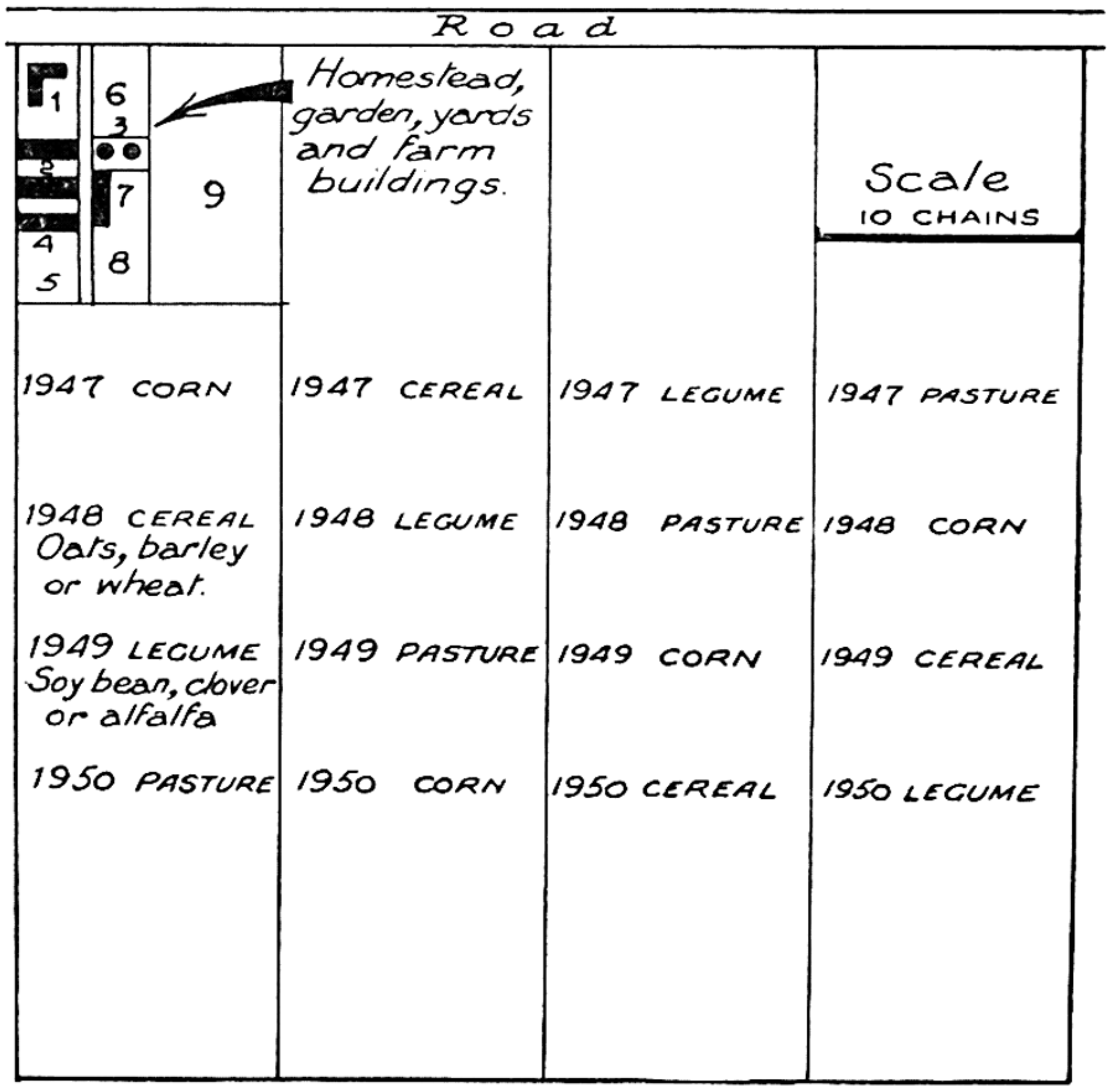

FIG. 97. Sketch-map of a typical corn belt farm to show a common method of crop rotation. KEY: 1. Homestead; 2. Barns; 3. Granaries; 4. Toolshed and chicken house; 5. Chicken yard; 6. Garden and orchard; 7. Pigsties; 8. Pig yard; 9. Overnight yard for cows and working horses.

(*d*) Buildings and yards are located in the corner of the property. The homestead is relatively small. The main buildings are the large barns and granaries used to store corn and fodder crops and to house the machinery and high-priced animals during the bitter winters. Cows for milk and horses for farmwork are also kept close to the buildings.

(*e*) The over-all acreage is 160. This is a typical subdivision of the corn belt area and is referred to as a quarter section.

Uses of corn in the United States. 1. Figure 98 shows that 87 per cent of the corn grown is used to feed the various types of livestock which form so important a part of the corn belt farm economy.

There are six reasons for this:

(*a*) Corn is too bulky in proportion to its value to be transported far from where it is grown, so it is consumed largely on the spot.

(*b*) Not only do animals represent concentrated corn in the form of meat, lard and other by-products such as leather, fertilizers, glue, etc., but they do much of the harvesting. Cattle and pigs are turned into the fields after the cobs have been harvested in order to eat the plants or any corn which may have been missed in the mechanical harvesting. Often the pigs are turned into the corn and allowed to eat the cobs as well as the plants. Where corn is cheapest, pig production is heaviest, e.g., in the western regions of the belt. As they make more pounds of meat per 100 lb. of feed than any other animal they are increasing in popularity. As for transport it is more economical to ship one pound of pig than five pounds of grain, which is the quantity required to produce one pound of live weight.

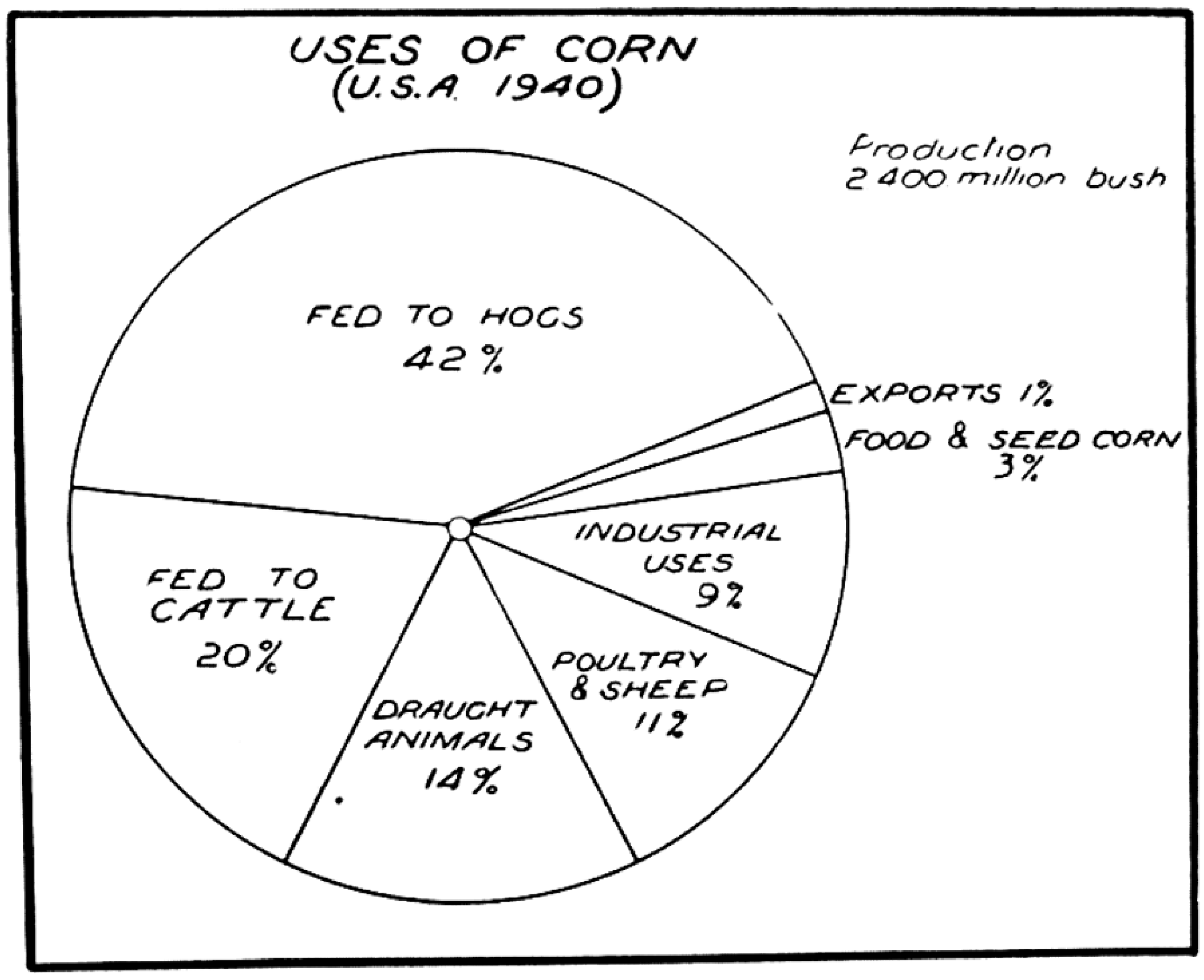

FIG. 98. Diagram showing the uses of corn in the United States.

(*c*) Corn is fed to beef cattle which are mostly bred throughout the corn belt, though some are brought from the western range country for fattening. Dairy cattle flourish near the larger cities, to which they supply milk products.

(*d*) The presence of animals in the corn belt in such numbers as to represent one-half the pigs and one-third the cattle means an important contribution in manures to maintain soil fertility. Crop rotation assists in this too, since a crop like maize quickly exhausts the land.

(*e*) Draught animals, like horses and mules, are raised for local use in association with mechanized agricultural implements and for sale to the cotton States of the south.

(*f*) Over half the chickens of the United States are raised in and about the corn belt. Large numbers of geese and ducks are also reared on the grain to supply meat and eggs to the industrial cities.

2. The industrial uses of corn are many and increasing; some of the most important include paper and fibre boards (from stalks and leaves), starches and oils.

3. Foods from corn find a wide and ready sale in the United States in such refined forms as flakes and syrup. As mentioned elsewhere, corn is a staple diet for the negro population of the southern areas.

Seed is naturally used for replanting and in recent years very successful experiments have been made in the production of high yielding hybrid maize.

4. Because of its bulky nature and the great and constant demand for local consumption as outlined above, it is natural to expect that only one per cent should be exported abroad, mainly to north-western Europe for food or for industrial uses.

Meat-packing centres (Figure 99). 1. Attention is drawn first to the size of the circles. Since they are approximately proportional to the value of output for each centre, it is possible to see the relative significance of the centres as a whole as well as to one another in certain regions, e.g., the corn belt.

2. Certain important facts arise from a study of this map, especially if others in the series are consulted for more detailed information (see Figures 94, 95, 96).

(*a*) The greater number of meat-packing centres are located west of the Mississippi. This is because most of the livestock concerned with this particular industry is found there, whereas most consumers live to the east of the river (see Figure 59). With cold storage, refrigerated rail trucks and fast traffic it is cheaper to move the bulk weight of packed meats than live animals. Few of these are now moved east to be slaughtered in the big industrial cities. If anything, the meat-packing centres are now moving westward closer to the fattening farmlands and the stock handling railheads.

(*b*) The main centres shown are mostly in or adjacent to the corn belt. They are Chicago, Kansas City, Omaha, Des Moines and St Louis. Chicago is the most outstanding because of its transport focus, wide variety of food processing industries and general relationship to the major agricultural regions of the interior of the continent. Kansas City is important too, since its position is such that stock pass through it from both grasslands and cornlands by major rail and road lines.

(*c*) In contrast with the general density of centres having close links with the corn belt are those farther west. Wichita, Oklahoma City, Fort Worth and San Antonio are near the great beef cattle lands of the south-west, while Ogden and Denver are isolated. Ogden, in an intermontane environment, is a transfer point for major rail lines and handles much livestock, whereas Denver as a gateway between mountains and plains draws on huge numbers of animals from both sources.

(*d*) The minor centres are those which, while having an export trade, cater for local county and State demands in various agricultural regions, e.g., the meat industries of Calgary, Regina and Winnipeg. This map, of course, could not show the innumerable smaller plants and abattoirs developed to serve simple town and city requirements.

(*e*) Of special interest are Toronto, which is the chief meat-packing centre of Canada; Oakland, which handles the livestock from its valuable hinterland of the Valley of California; Portland and Seattle, with important trade connections in the Willamette Valley in one instance and the Pacific coast in the other; and Spokane, meeting the demands of a population where railway shops, lumbering, wheat-growing and mining are the main occupations. Finally, there are the great metropolitan areas to the east, New York and others on the Atlantic seaboard. Their meat-packing industries have long historical associations with the period when stock were moved through the gaps, e.g., the Cumberland Gap, to be treated at the tide-water ports. To-day the significance of the industry derives from the huge populations to be fed, the abundance of labour, power and related industries.

3. This map may be contrasted profitably with that relating to the meatworks of Australia (Figure 60). There are not only marked differences in the over-all pattern but in the numbers, the specific locations, the functions and the markets served. The centres in Australia are concerned almost wholly with beef cattle processing, whereas North American meat-packing is associated with a wider variety of livestock, of which the most important are cattle and pigs. Also the meats are put up in many forms to meet the multiplicity of tastes and diets which exist in the population. The industry in America is highly organized technically, with extensive advertising and publicity.

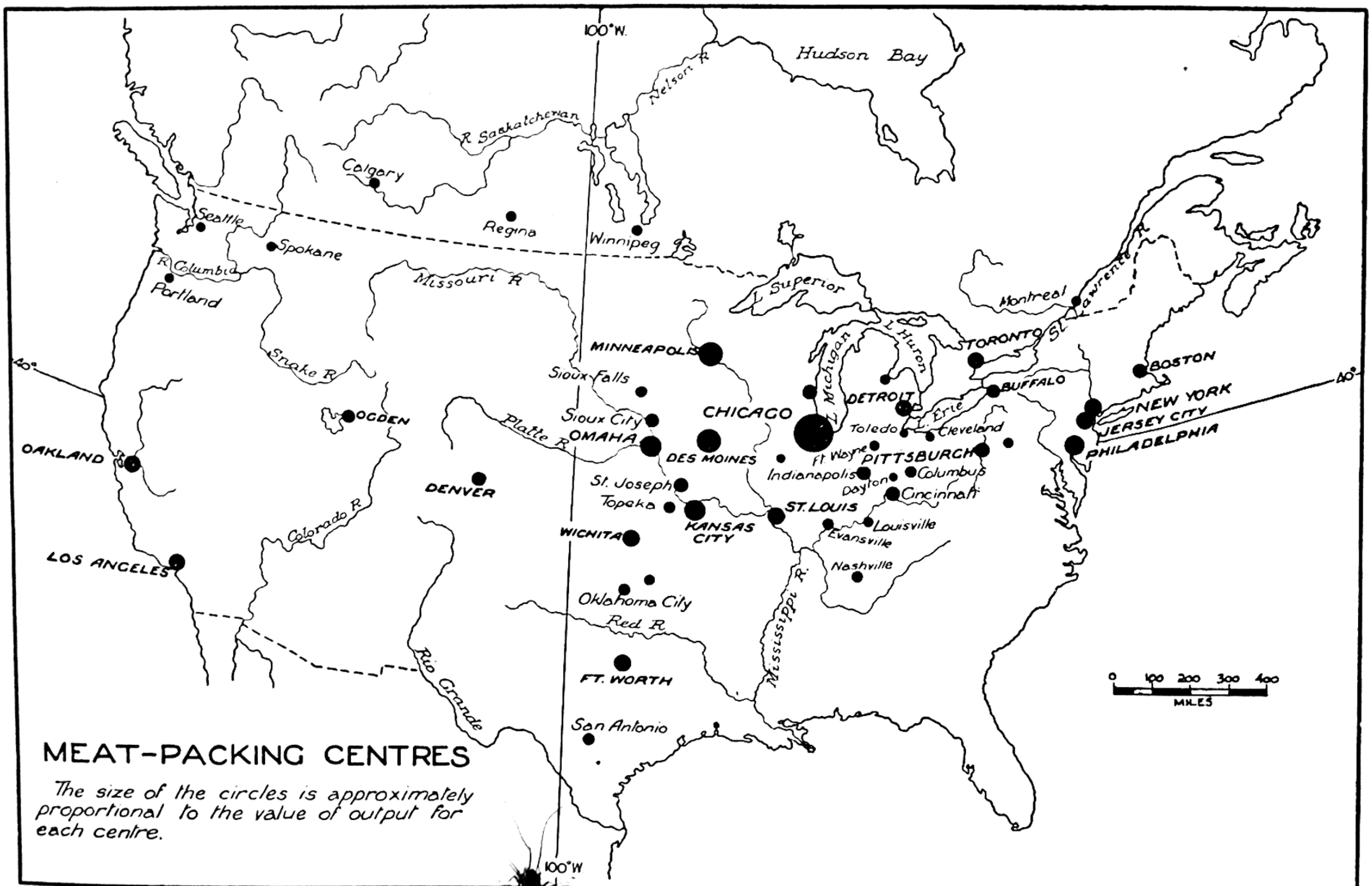

FIG. 99. Meat-packing centres in the United States and Canada (*After Bureau of Statistics, U.S.A.*).

DAIRYING IN AUSTRALIA

Distribution (Figure 100). Contrasted with the raising of beef cattle, commercial dairy farming is an intensive form of land utilization, and one of the most advanced types of agriculture. The industry uses a small acreage for each animal. Milk production is an activity that demands a large intake of good quality food. Dairy cows, therefore, require good pastures, or a continuity of good feed for the greater part of the year, as well as adequate water supplies. Where pastures are unable to maintain the feed supply, resort must be had to cultivated crops. In Australia the good dairy pastures invariably consist of introduced species of grasses and clovers. The native grasses do not make good dairy pastures.

The perishable quality of bulk milk means that it must be consumed or processed soon after production; so there is a need for quick and efficient transport to towns and factories, which pasteurize the milk and make dairy products. This explains why, in the early stages of the industry in Australia it was strictly localized either about towns needing milk supplies, or, in the more distant parts, where butter and cheese were

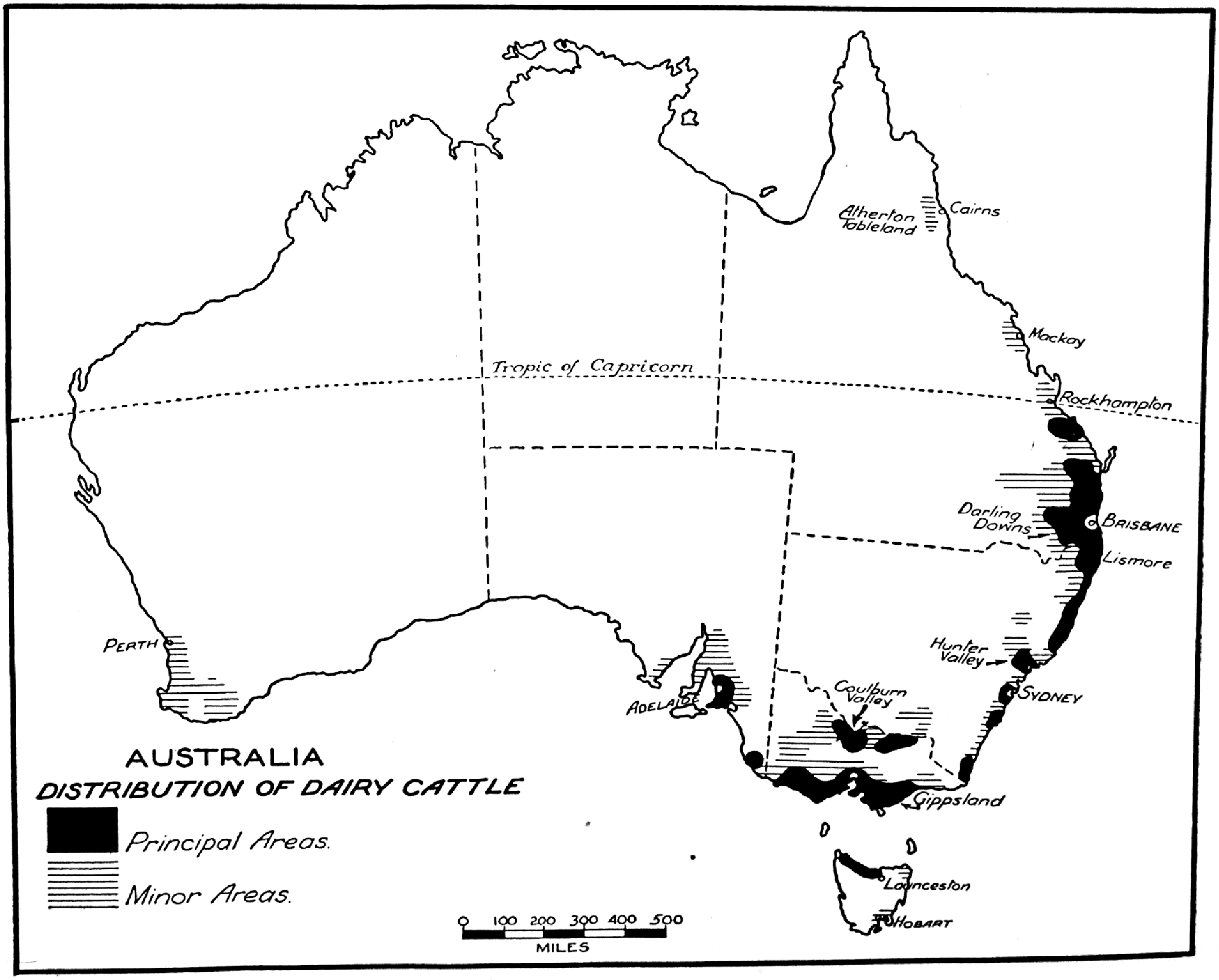

FIG. 100. Distribution of dairy cattle in Australia.

made. Later expansion was made possible, in part, by the development of refrigeration, better transport (such as the motor truck which enabled the milk to be carried for longer distances to the factories), mechanization on farms and the introduction and cultivation of pastures along with the conservation ot fodder. It was thus that the pattern shown on Figure 100 arose.

More detailed studies are made of dairying in the eastern States in a later section of the text (Figures 103, 107, 110), but certain general observation of the Australian industry may be made here.

1. Dairy cattle are concentrated mainly in the better rainfall areas which fringe the Australian continent, since a fairly uniform and reliable rainfall guarantees the required green feed for the greater part of the year.

2. The greatest density is in the coastal districts and, with the exception of Victoria, dairy stock are found chiefly in the coastal valleys and the tablelands which adjoin them. An interesting example of the latter is the Atherton Tableland, where temperatures and soils provide suitable pastures, although the area is within the tropics.

3. Irrigated areas in Victoria, New South Wales, South Australia and Western Australia support many dairy cattle. Here the natural summer pastures are irrigated to encourage growth and the winter feed is provided by conserved fodder grown on irrigated land during the summer months.

4. In the drier inland regions about the south-east and south-west of the continent (shown by horizontal shading on the map), dairy herds are possible because improved pastures together with supplementary fodder are sufficient to meet the needs of local markets for milk and some butter manufacture.

5. About the major cities, with their urgent demand for whole milk, herds are maintained on relatively poor land mostly by continuous hand feeding. These are more independent of climatic conditions than the pasture-raised stock.

6. The principal fodder grasses are all imported, since the native varieties are not good enough. Paspalum, kikuyu and perennial rye are three of the best known, but all exotic types must be suitably selected and cultivated to meet the special soil and climatic requirements of each district. As already mentioned they must also be supported by fodder crops which have to be grown, harvested and stored as silage to provide winter feed. Sorghum, cow-cane, maize and oats are the chief fodder crops in the summer rainfall regions; in the winter rainfall areas of Victoria, South Australia and Western Australia the greater part of the conserved feed (hay or silage) is obtained from the pasture surplus during the spring flush of growth. In many oversea countries (such as those in Western Europe, the United States and New Zealand) the dairying industry is characterized by year-long hand feeding on cultivated green fodders, silage and grains. Here the average yield of milk per cow is two or three times that of Australian cows. All too few Australian farmers practise this form of conservation and regular supplementary feeding. In recent years there has been some little improvement in pastures and fodders mainly brought about by the educational efforts of the various State Agricultural Departments.

7. There are indications of an increase in mechanization on dairy farms, e.g., practically all farms have milking machines and there has been considerable development of mechanization of the cultivation of fodder crops and hay making. The shortage of farm labour has been important in encouraging this development.

8. The products from dairy farms cover a much wider range than is often realized. As well as milk, butter and cheese, there are such processed foodstuffs as powdered and condensed milk, ice-cream and casein. Side-lines include the raising of pigs and calves, with some vegetables e.g., peas and beans. Altogether there has been a decline in the production of butter, with more whole milk being used both for immediate consumption and for turning into the goods just mentioned. Factories are tending to become bigger with centralization, leading to the elimination of the smaller plants in the various districts (see Figure 106).

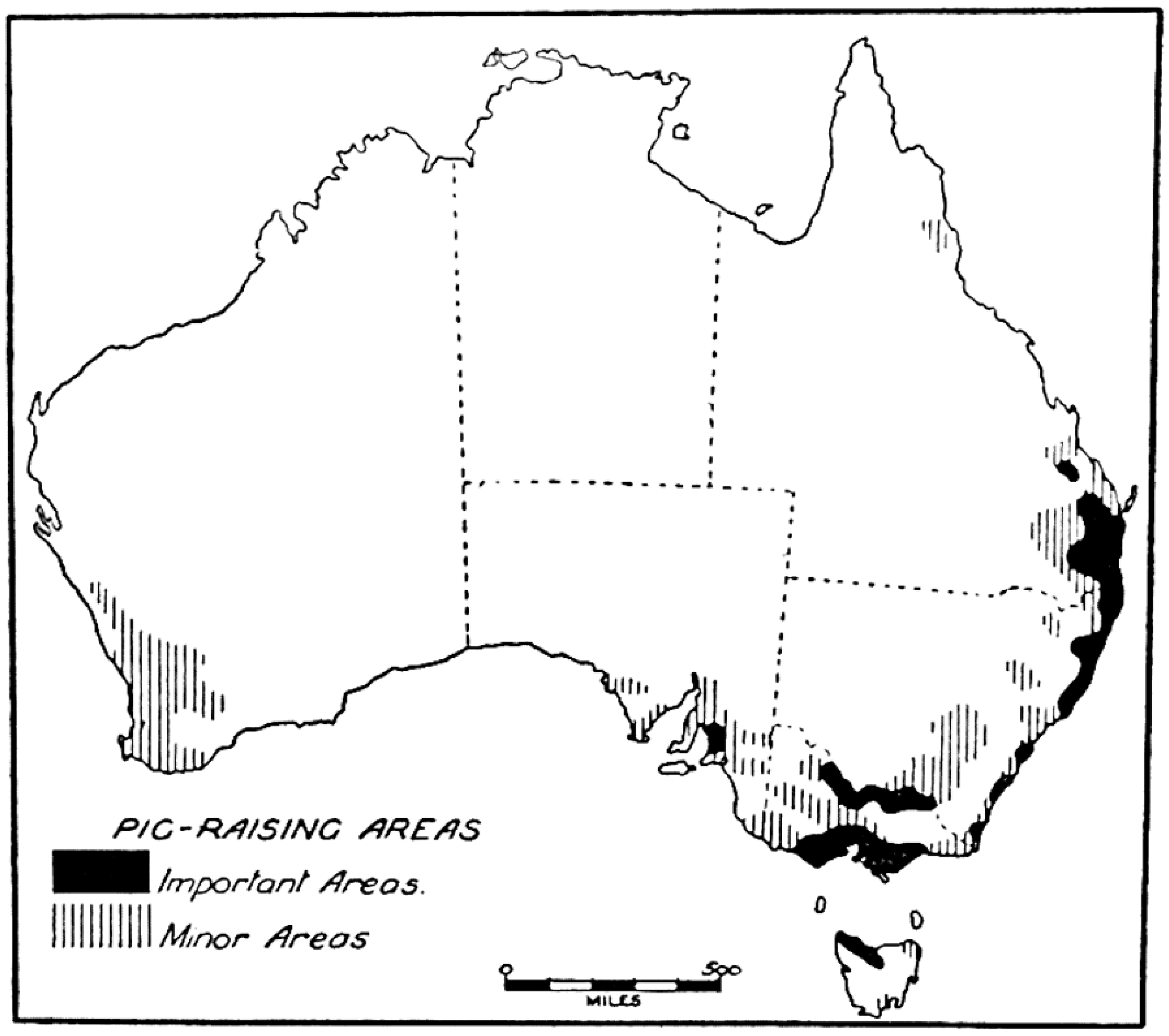

FIG. 101. Pig-raising areas in Australia.

Pig-raising areas in Australia. Pig-raising in Australia is not a large and separate industry as in the United States. Rather is it a side-line to dairying and mixed farming. This accounts for the pattern of distribution as shown on Figure 101.

Pigs are reared mainly in the eastern States (New South Wales, 30 per cent and Queensland 32 per cent of Australia's total) where they are fed principally on a by-product of butter-making, i.e. skim milk, and limited amounts of grain such as maize, as on the north coast of New South Wales. But for a highly developed industry to meet the wide demands of various markets, considerable quantities of cereal foods are required and it so happens that:

(*a*) Regions of such cereal production are generally some distance from the dairying centres.

(*b*) Cereal farmers can usually market their grain at higher prices than the pig farmer can afford. On the other hand when low prices are offering for wheat, pig-raising on wheat farms increases. With rising prices for wheat, interest in pigs is lost and production falls.

(*c*) In the dairying areas, where milk is supplied for distribution as whole milk or for the manufacture of dried milk, ice-cream, cheese or casein, pig production has, after a while, practically ceased to exist.

(*d*) The local demand for pig products is affected by the large and popular amounts of other meats available to the Australian public.

From the above it can be seen that certain factors retard the pig industry in Australia. Some agricultural experts maintain that if wider markets for pig products could be found, this particular animal industry might be made more important by three measures:

(*a*) More intensive mixed farming might develop in the better favoured regions of the continent, particularly in the grain-growing areas, as in the United States. Actually Australia is potentially better off than most pig-raising countries with its all the year open grazing conditions and natural pastures and its freedom from any need to import cereal grains, as for example in Denmark.

(*b*) More use might be made of the valuable advice of expert officers from the various State Departments of Agriculture with respect to pig breeding, housing, methods of feeding and importation of bloodstock.

(*c*) The better organization of the treatment, transport and sale of the meats.

All products of pigs are of marketable value. Pig production has become an industry of economic importance throughout the world, since in addition to pork, bacon and ham, there are numerous by-products. These include various types of preserved sausages, lard, trotters, liver, kidneys and other commodities such as bristles, pigskin, gelatine, cosmetics, lubricating oils, candles, glue, soap, pharmaceutical preparations and fertilizers.

Dairy farming in New South Wales. Figures 102 and

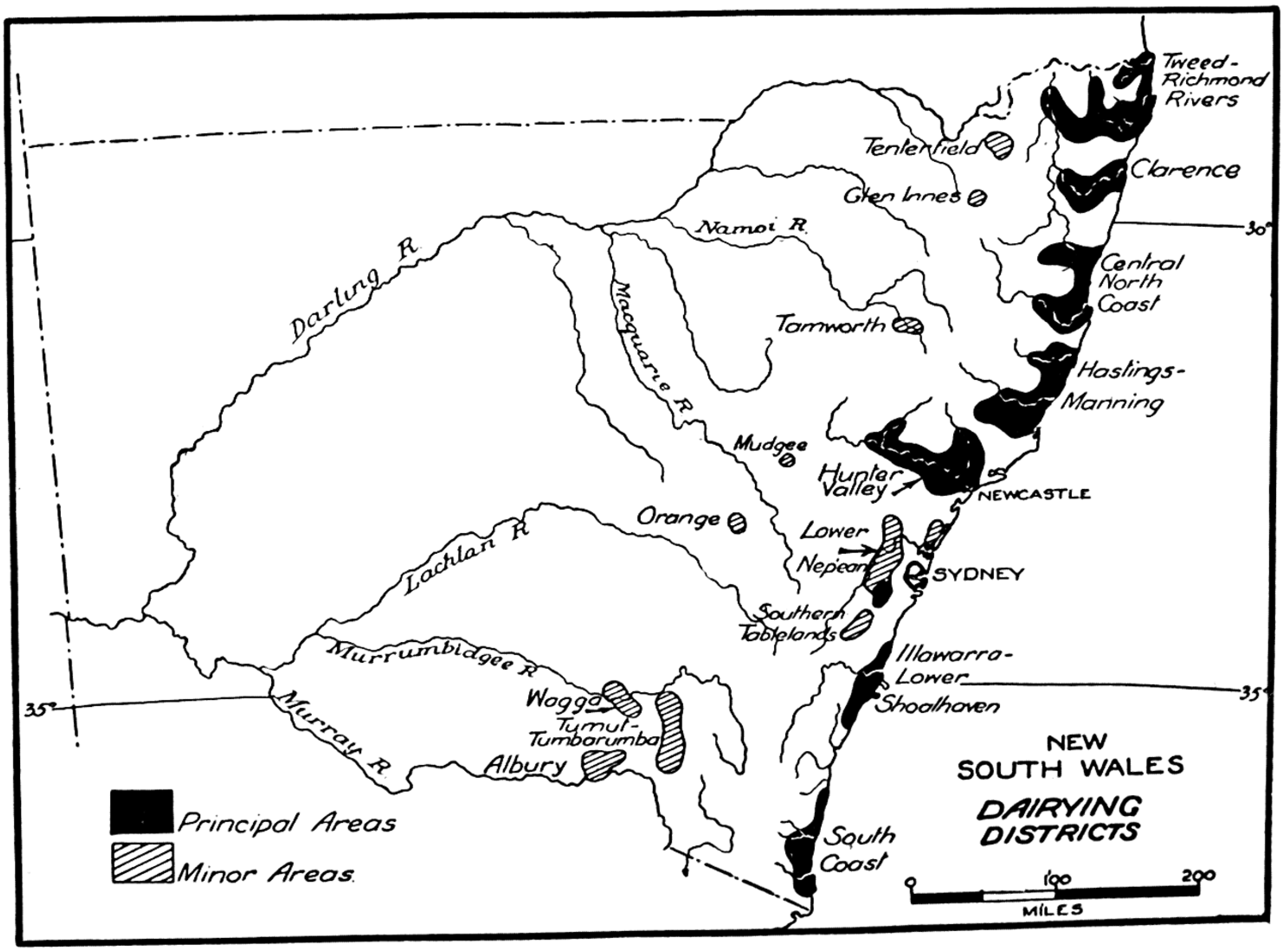

FIG. 102. Dairying districts of New South Wales.

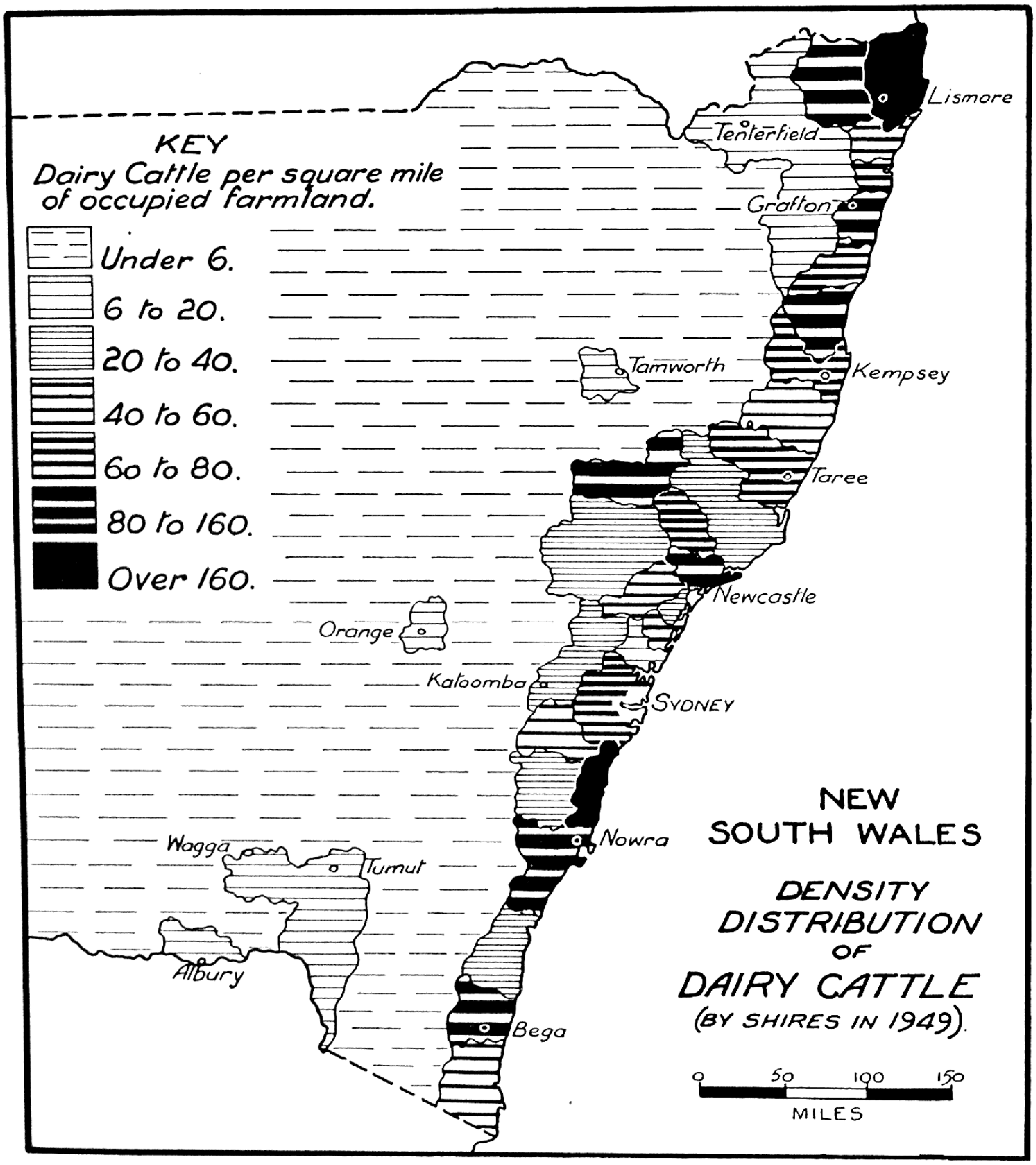

Fig. 103. Density distribution of dairy cattle in New South Wales.

103 can best be examined together as providing both the location and animal density of the major areas of production. Both sketches reveal the over-all importance of the coastal areas of the State, at the same time indicating small localized centres on the tablelands and slopes.

1. The rich silts of the lower riverine plains vary from 10 to 20 miles in width and are capable of producing heavy growth of grasses, e.g., paspalum and kikuyu. The richest soils are of volcanic origin and account for the great stock density of the Tweed-Richmond region and the Illawarra district.

2. An abundant annual rainfall (ranging from 40 inches on the south coast to over 70 inches on the far north coast), associated with warm to sub-tropical summer temperatures, promotes grass growth and contributes to the production of extensive fodder crops, e.g., sorghum, maize (the main one in summer) with saccaline, wheat or oats as rotation crops for winter. The climate is also favourable to dairy stock and permits all the year round grazing and farm activities.

3. Areas of lower density on the whole represent (*a*) hilly timbered lands which divide the main drainage systems; or (*b*) immature and poor podsol soils.

4. The milk produced is utilized in several ways:

(*a*) It is consumed in towns, especially in the large

urban centres of Sydney, Newcastle and Wollongong; these absorb huge amounts daily from districts up to 300 miles away in the case of Sydney.

(*b*) It is made into butter, for which 60 per cent of the milk is used. Some high-grade butter is exported overseas.

(*c*) Ice-cream, cheese, powdered milk, condensed milk and casein are manufactured; the three latter often in conjunction with butter.

(*d*) Skim milk (from separation for butter) is fed with some maize to pigs. There is nothing comparable in this livestock association to that in the corn belt of the United States.

5. Factories, mostly based on the co-operative system, though some large ones are owned by private companies, occur throughout within easy transport of farms up to 40 miles distant.

6. The farms vary in size from 50 to 150 acres or more and occupy land of a varying character, e.g., arable river flats, lower hill slopes and rough grazing hill lands. The section diagram in Figure 104 illustrates typical dairying land on coastal New South Wales. The diagram and legend should be studied carefully. The actual land use is illustrated by two maps of farm lay-outs in the Hunter Valley. Figure 105 (*a*) is a 55-acre property where the emphasis is on the production of lucerne, vegetables (cauliflower, pumpkin and cabbage) and potatoes on the rich river flats. Such dairying as is done on this farm is incidental to the crop production. Figure 105 (*b*) is a larger holding of 137 acres supporting some 50 cows. Here the emphasis is on the production of milk. Sixty acres of this farm are river flat and the remainder is cleared pasture. The diagram shows that only half of the flats are cultivated, with the remainder being under paspalum and clover. The crops grown are used mainly for fodder for the herds, but there is some sale of surplus hay. The cows are milked twice daily and the morning milk is taken to the roadside, where it is left, in a stand, together with the cream separated from the previous evening's milk, to be collected by a milk lorry. The separated evening's milk is fed to calves and pigs, as these form an important sideline to the dairying.

The house, situated on the higher ground, is of weatherboard with six rooms and is surrounded by a neat garden. Water is laid on to the house, bails and several of the pig troughs. The bails are of wood and have a concrete floor. They are fitted with a milking machine and the farmer also owns a tractor and a haybailer for the crop cultivation.

7. The main townships marked represent in most cases former heads of navigation for coastal trading ships. They provide markets and transport facilities for the farming districts as well as service industries and civil amenities. They cater not only for the dairy industries, but for timber-getting, sawmilling, small

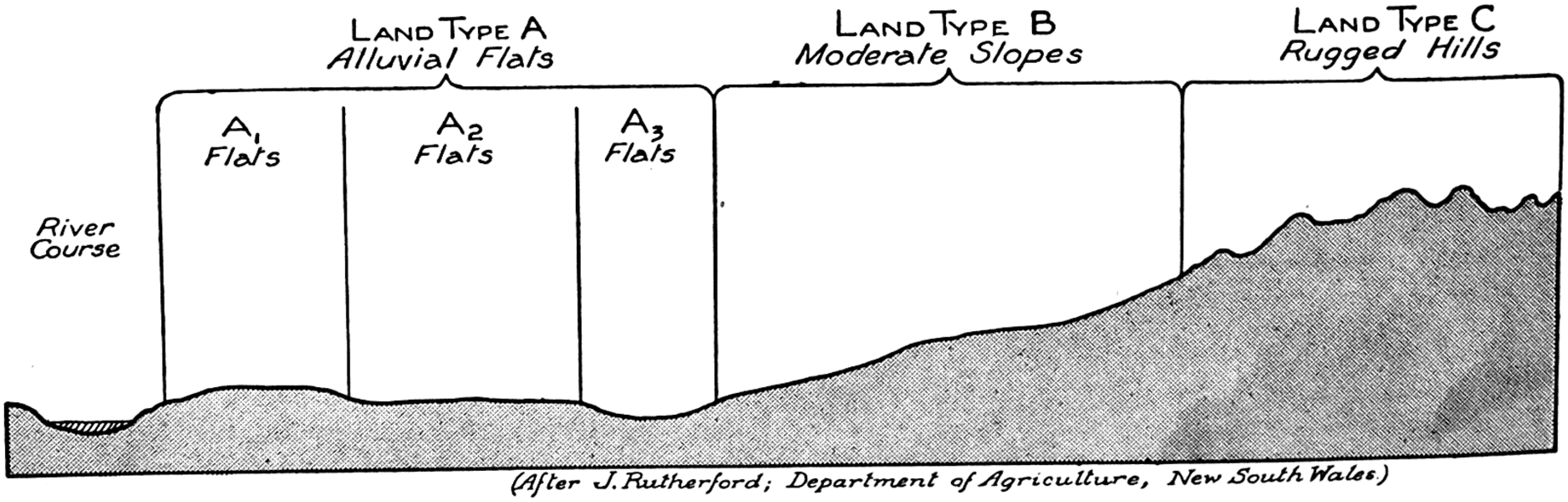

FIG. 104. Sketch diagram showing land types in coastal river valley dairy district.

Land use occurring in typical association with these land types is:

Land type A: Alluvial flats.

Sub-type A_1: First quality alluvial flats with well-drained soils used for the production of fodder crops.

Sub-type A_2: Second quality alluvial flats used for grazing the milking herds on paspalum, kikuyu and improved pasture grasses. Much pasture subdivision and rotational grazing.

Sub-type A_3: Badly drained alluvial flats with swamp pasture, often of little value except for feed in dry times.

Land type B: Moderate slopes, used mainly for grazing of the milking herd on paspalum. Some rotational grazing in subdivided paddocks and some pasture improvement and cropping on deeper soils.

Land type C: Hilly and rugged areas used mainly for grazing "dry" dairy cattle and beef cattle on natural pastures.

factories, and in the case of the far north coast, sugar processing, e.g. Murwillumbah on the Tweed.

8. A series of corridor roads and railways as well as local highways serves these areas. These serve to transport the products from the farms and factories to the city markets and wharves for export.

On the whole dairying pays better all the year than most kinds of farming in the State and can employ a complete family in its many and continuous activities.

The other areas shown on the maps may serve as suppliers of whole milk or butter to nearby townships. There may be a special emphasis on cheese as on the tablelands—generally too rugged for dairying—or the far south coast. The location of inland dairying districts may depend on the presence of certain landforms, and climatic conditions favourable to the production and handling of milk, e.g., the Tumut plains.

Of special interest is the area immediately surrounding Sydney, dealt with in *Regions and Men*.

Factories processing dairy products in New South Wales. Figure 106 shows a close relationship with others of the series devoted to dairying in New South Wales, and the following points may be noted regarding it.

1. The large amount of dairy products obtained from the processing of whole milk and cream after considerable quantities of it have been absorbed as whole milk by the urban populations.

2. The variety of manufactures as indicated by the range of symbols on the map. This present state is in marked contrast with the earlier years when, with poorer herds and less efficient dairies and factories, butter and cheese were almost the sole foodstuffs pro-

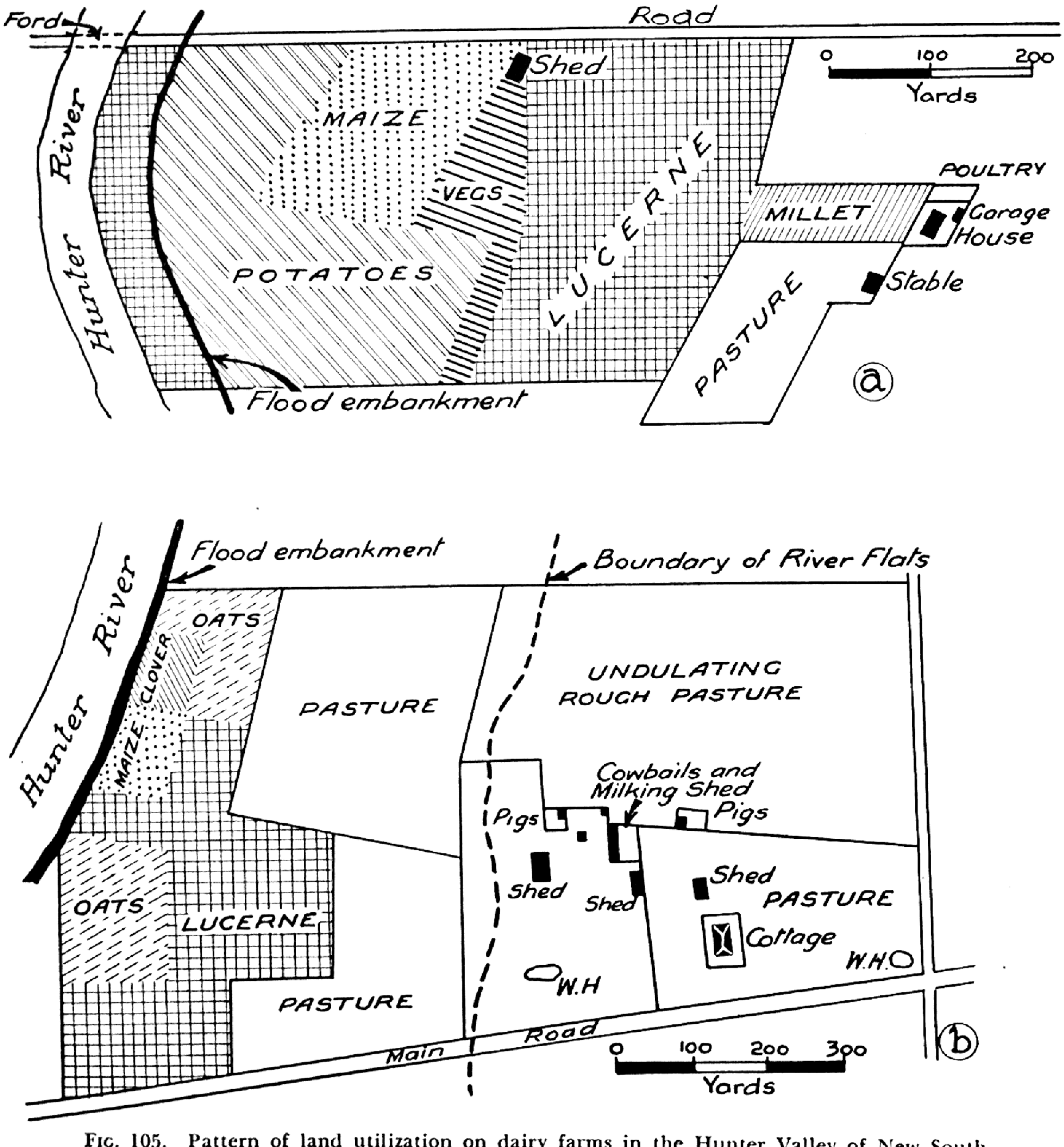

FIG. 105. Pattern of land utilization on dairy farms in the Hunter Valley of New South Wales (*After W. H. Maze*).

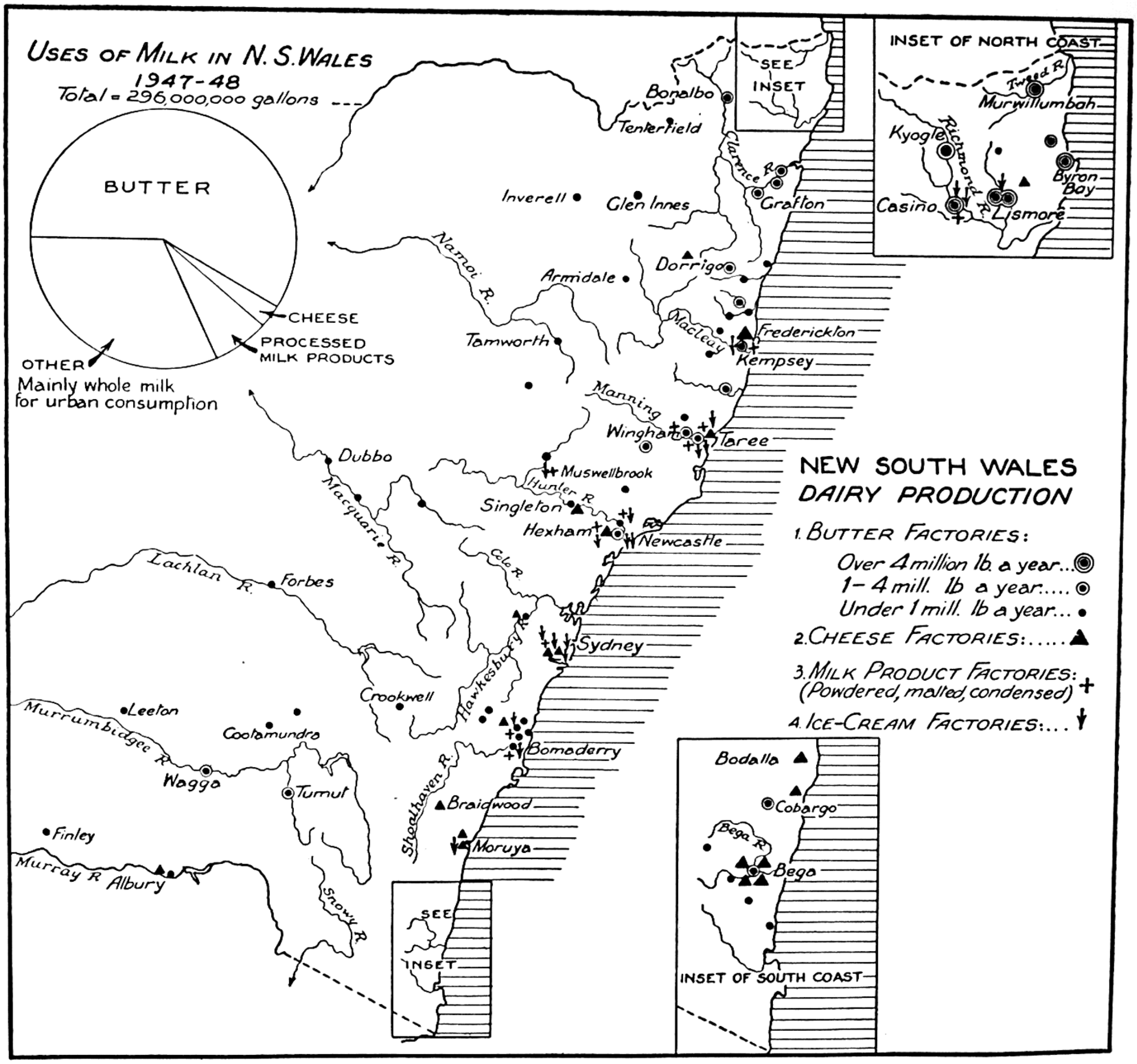

FIG. 106. Location of dairy products processing factories in New South Wales.

duced by processing. Because of the greater profit obtained there has been a rapid expansion of the dried milk industry since World War II.

3. The main concern of the large far north coast factories is with the making of butter as against the concentration on cheese in the far south coast. In both areas distance from the metropolitan markets is a major factor precluding the sale there of whole milk, though in 1951 some milk was brought from Grafton and Lismore when the pastures nearer to Sydney were affected by drought (see Figure 112 and notes thereon). Ice-cream is made in several Sydney factories and at Taree and Newcastle for the Sydney market as well as for local markets. Powdered and condensed milk types have a State-wide sale as well as a large export to tropical lands north of Australia.

4. The size, number and concentrated pattern of factories on the coast offer a contrast with the distribution and productivity on the western slopes. In the latter districts the townships cater for surrounding populations except in the case of Wagga and Tumut.

5. On the north coast there has been a marked consolidation of the butter manufacturing into a few large factories. Thus, in the Tweed-Richmond area in 1951 there were only six large and two small factories as against over 25 factories in 1939. The large factory has proved more economical and fast motor transport over good roads has solved the problem of transporting the cream for distances up to 50 miles from the factory.

6. For all areas the factory location is on or near rivers, since a constant supply of fresh water is important in this type of manufacturing. In coastal areas the chief factories are generally found in the

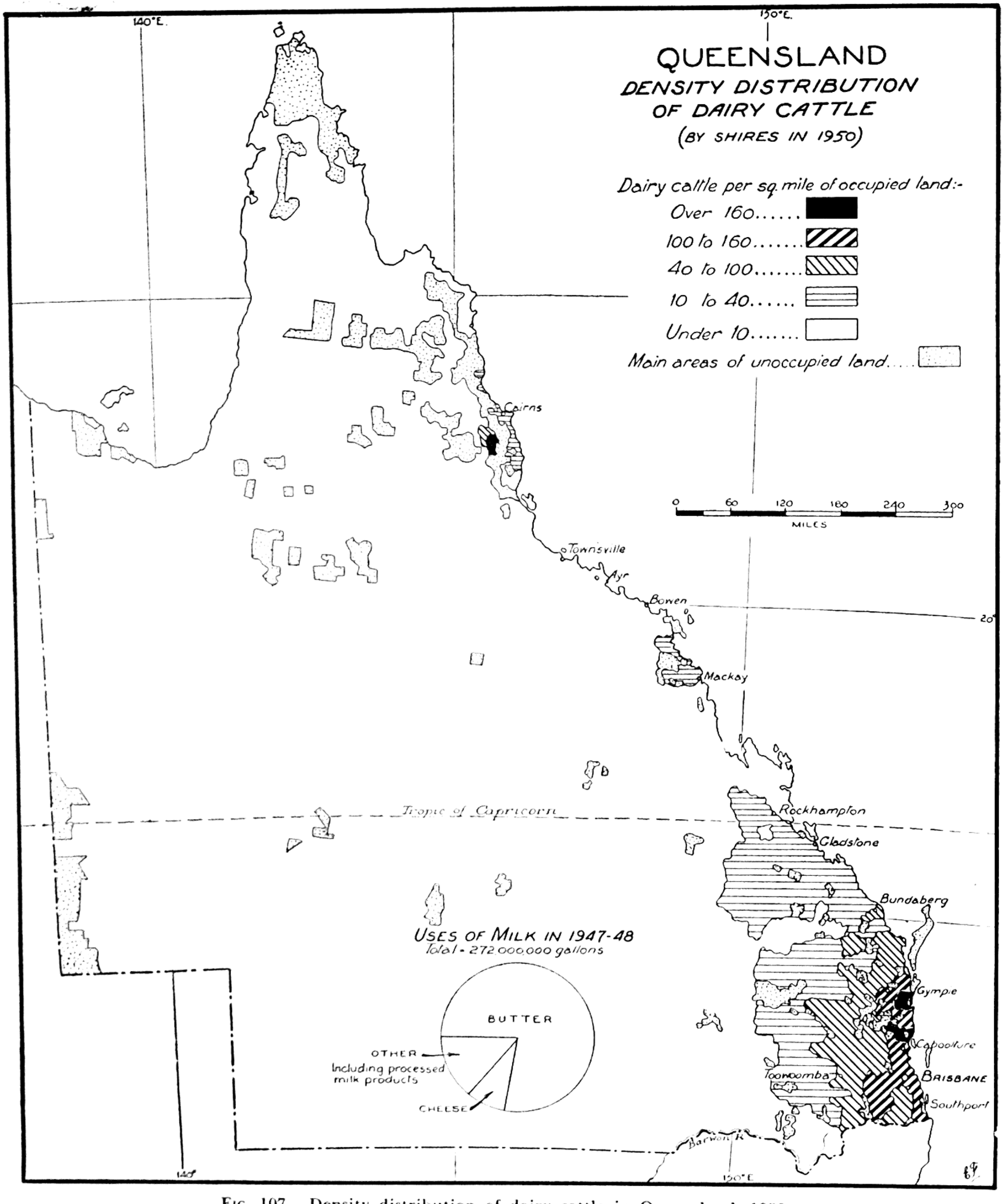

FIG. 107. Density distribution of dairy cattle in Queensland, 1950.

service and transport centres of the middle valleys. Here they have close ties with the farms of both the upper and lower sections. But where milk production may be especially high, a series of small factories or a couple of large ones may occur, e.g., the lower Manning River, the Hunter Valley and Bomaderry.

7. Factories in areas supplying milk to metropolitan populations are concerned mainly with blending and chilling milk before transport to the city depôts. Some may turn to butter-making (or dried milk manufacturing) when the local milk supply is too great, as in flush periods, e.g., the Illawarra district and Muswellbrook.

8. Many butter and cheese factories work as co-operative units with important administrative and cold storage facilities in the cities, where products are

concentrated prior to export or retail. Such companies provide the farmer members not only with a share of profits made, but with such commodities as fertilizers at special rates. Private firms control most of the other manufactures.

9. Interesting comparisons can be made with the dairy production of the other eastern States.

Queensland dairying industry. Figures 107 and 108 show the dairying industry of Queensland to be located mainly in selected areas along the coastal strip from the New South Wales border to Cairns, in the hinterland of the larger river valleys, and on the tablelands of the Atherton Tableland and the Darling Downs. The greatest production is from the south-east corner and the geographical factors accounting for this are very similar to those governing the industry in New South Wales. Certain other details must be noted:

1. Regions in the vicinity of Brisbane and stretching north to Maryborough have considerable specialization in dairy farming, with the emphasis on butter production together with some whole milk for the urban market in Brisbane. The dairying here is often carried on in a mixed farming economy with sugar, maize, beans and peanuts as associated products, according to the locality. Processing here is mainly for butter but there are several ice-cream factories in Brisbane. The only dried milk factory in Queensland is at Southport.

2. The Atherton Tableland is well within the tropics, but elevation, soils and an abundant rainfall favour the industry which, though small, is of growing importance. Clearing of the dense tropical vegetation is still an obstacle in this area but the spread of hydro-electricity should materially assist development.

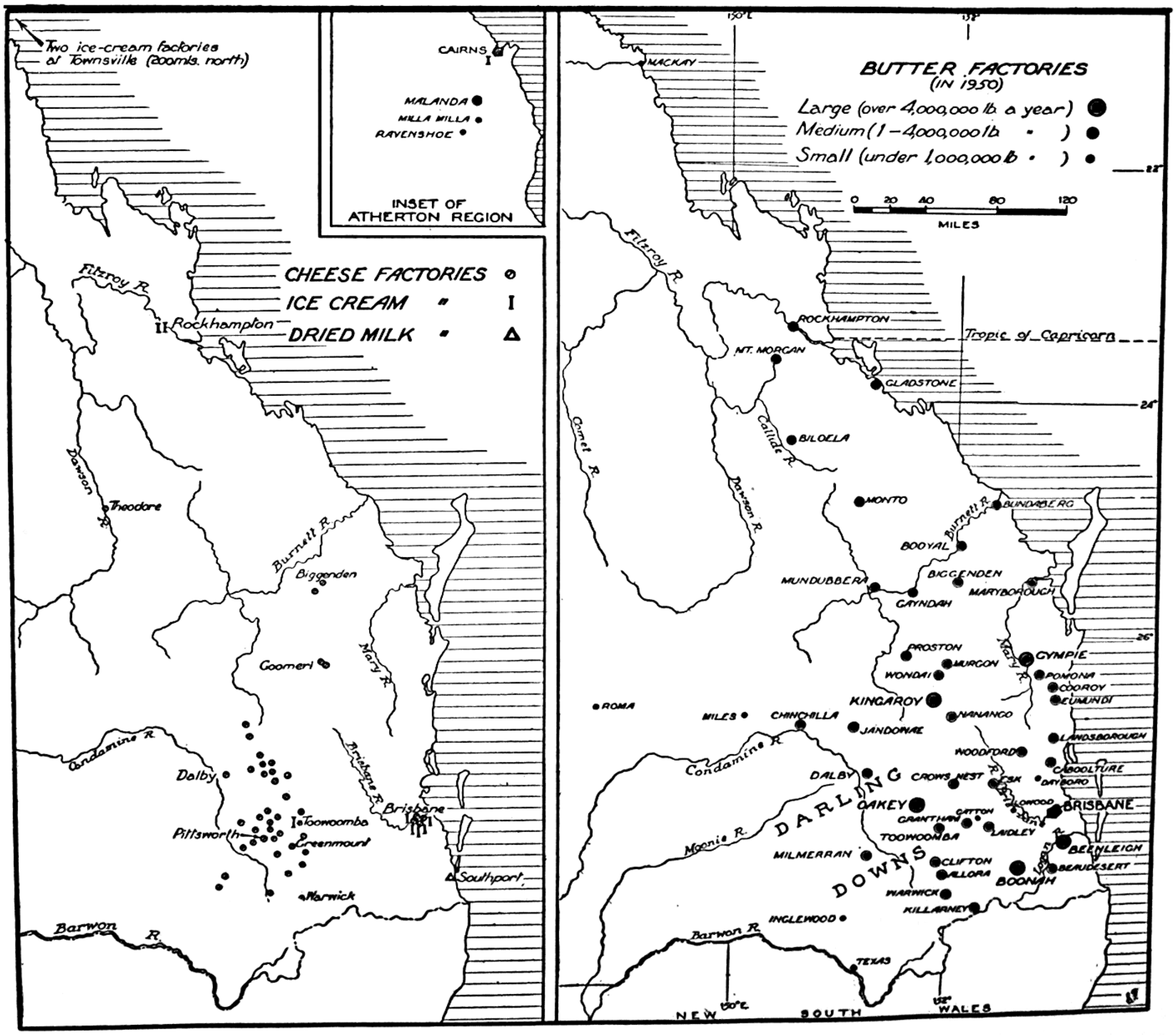

FIG. 108. Dairying processing industries in Queensland, 1950.

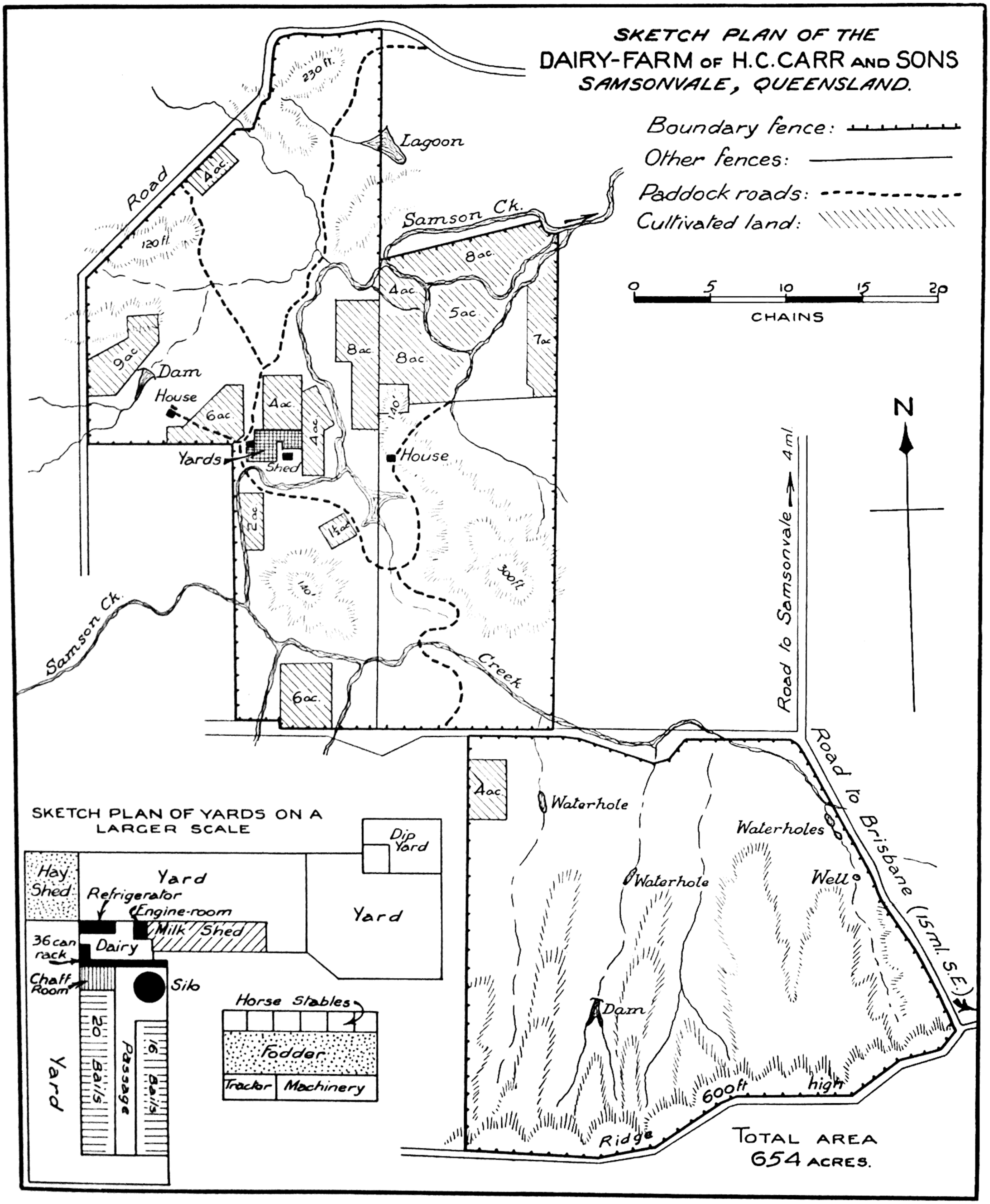

FIG. 109. Sketch plan of a Queensland dairy farm.

3. Almost all the cheese in the State comes from the Darling Downs, where a succession of cultivated fodder crops enables a fairly high number of dairy stock to be maintained. There has been a marked consolidation of cheese-making into fewer and larger factories in the past 10 years, just as butter manufacturing has been consolidated on the north coast of New South Wales. Butter is also of considerable importance in the Downs area.

4. Queensland has approximately the same number of dairy cattle as Victoria and New South Wales, but its production of cheese and butter is less than that of those States.

A Queensland dairy farm. Figure 109 is a sketch plan of a dairy farm some 15 miles north-west of Brisbane and the following points are worth noting:

(*i*) It is situated on Samson Creek, a tributary of the Pine River, which drains the eastern foothills of the D'Aguilar Range.

(*ii*) The landforms consist of undulating to hilly country flanking alluvial flats along the main creeks. To the south the land rises to a rugged ridge about 600 feet in height.

(*iii*) The rainfall is approximately 50 inches a year with a marked maximum in summer. Temperatures are hot and muggy in summer, but mild in winter. Winter frosts occur occasionally on the lower flats.

(*iv*) Originally covered with rain forest and eucalypt forest, it has now been cleared except for timber on the more rugged hills.

(*v*) The total area of the farm is 654 acres, but much of it is either too rugged for grazing or suited only for rough grazing for dry cows.

(*vi*) Reference to the map will show that about 80 acres are cultivated for fodder crops. The principal crops grown are maize, cow-cane, barley and oats. These are cut and stored in the hay sheds, chaff shed or silo.

(*vii*) On the average, some 60 milking cows are kept, as well as two working horses and a pony. Pigs are also bred, being fed largely on the separated milk.

(*viii*) This farm is managed and worked by Mr Carr and his eldest son. A little rotary hoeing is let out by contract.

(*ix*) The cows are milked twice daily by milking machines in an airy, clean, concreted dairy building (see inset plan on the map). The milk is separated by engine-driven separator and the cream is taken each morning to a stand on the nearby road to the north of the house. Here it is picked up by a lorry which takes it to a butter factory at Dayboro, about 12 miles to the north. The cream lorry returns in the afternoon with the empty cans, mail and household supplies for the farms along its route.

(*x*) Most of the separated milk is piped by gravity to the pig-pens; the remainder is kept for feeding poddy calves.

(*xi*) The homestead is soon to be linked with an electric power line being erected through the district. At present cooking is done on a fuel stove and night reading by means of a kerosene pressure lamp. There is also a kerosene refrigerator. There is a party telephone line linking the farm with Dayboro (Figure 108).

(*xii*) This is a progressive and well-managed farm and the family is well satisfied with the life. The elder son plans to take over the farm when his father retires and hopes to improve it by building some irrigation schemes. The younger boy, at present at school, also hopes to go on the land, where he may reap those intangible benefits of farm life that the city dweller can never really appreciate.

Victorian dairying. Figures 110 and 111 reveal a fairly strong localization of dairying districts in Victoria. Their associated activities, including factories, are governed by much the same geographic circumstances as in the other eastern States. A notable exception to these is the extensive use of irrigation in the Murray Valley. It might be noted too, that the industry is virtually non-existent in the rugged forested uplands to the east, and the dry country to the west and north-west. By way of marked contrast with this absence of dairying over fairly large areas, certain favoured parts have a density of dairy stock in occupied farmland rising as high as over 80 per square mile. Interesting comparisons and contrasts can be made about Victorian agriculture as a whole by studying these two maps in association with those showing that State's distribution of wheat, sheep, vegetables and orchards (see Figures 71, 81, 127 and 131).

1. **Western districts.** Covering roughly an area extending from Geelong to Hamilton, Coleraine and Portland, the western districts consist mainly of fertile plains weathered from basalt or laid down as river alluviums. With good rains these have produced excellent dairy pastures. Cool climatic conditions have also assisted in a large production of butter and cheese as indicated by the concentration of factories. Other animal industries include mutton sheep, beef cattle and pigs, while vegetable growers produce mainly potatoes and onions.

2. **Gippsland district.** The more important dairying lands here are situated in the great Victorian rift valley and are made up of river silts derived from the highlands e.g., the valley of the La Trobe. These parts may have a rainfall of over 30 inches. In the less favoured sections (e.g., Sale), irrigation and sown grasses have aided production. As Figure 111 shows, the greatest concentration of factories in Victoria occurs in Gippsland in a series of market towns, although much whole milk for Melbourne also comes

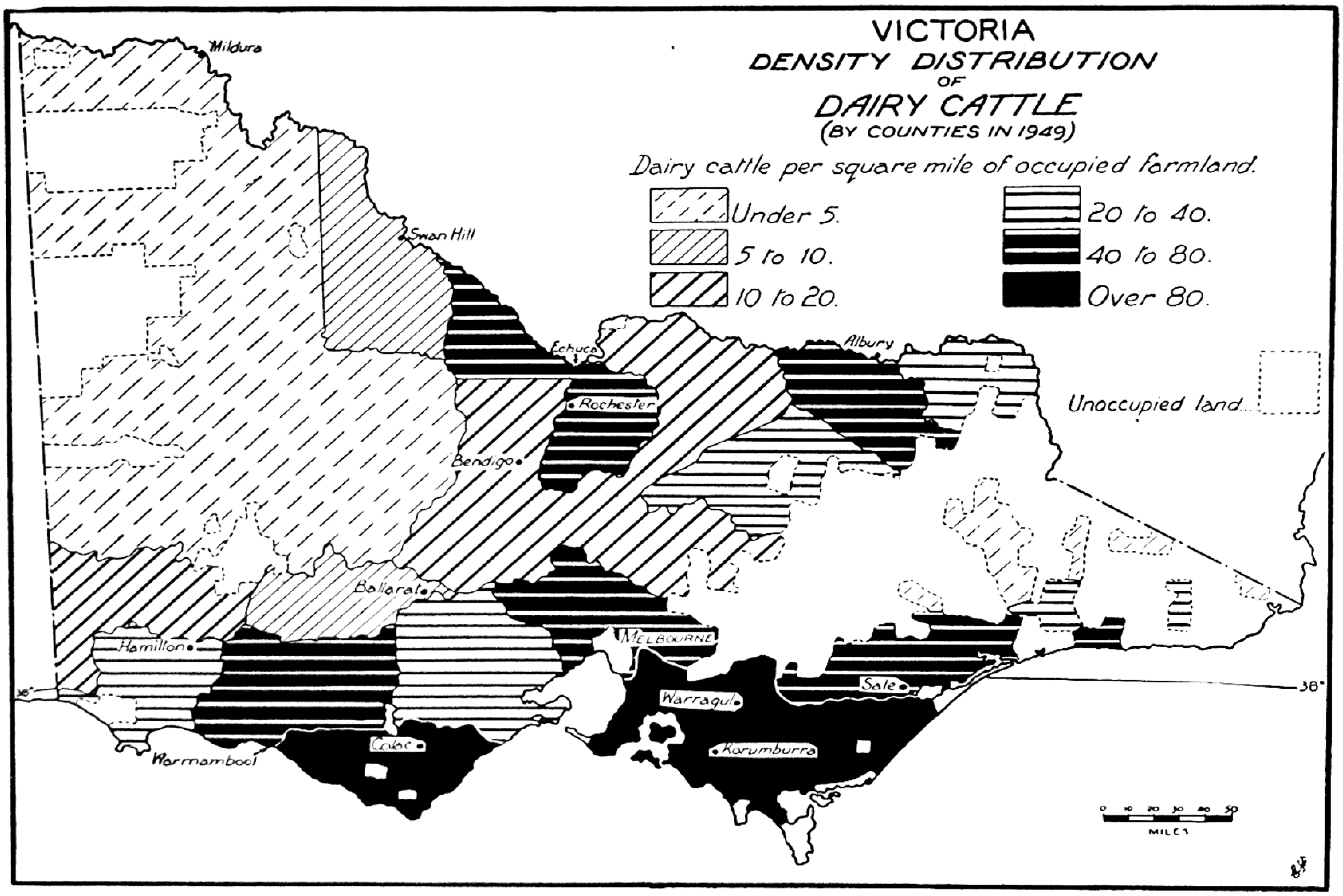

FIG. 110. Density distribution of dairy cattle in Victoria, 1949.

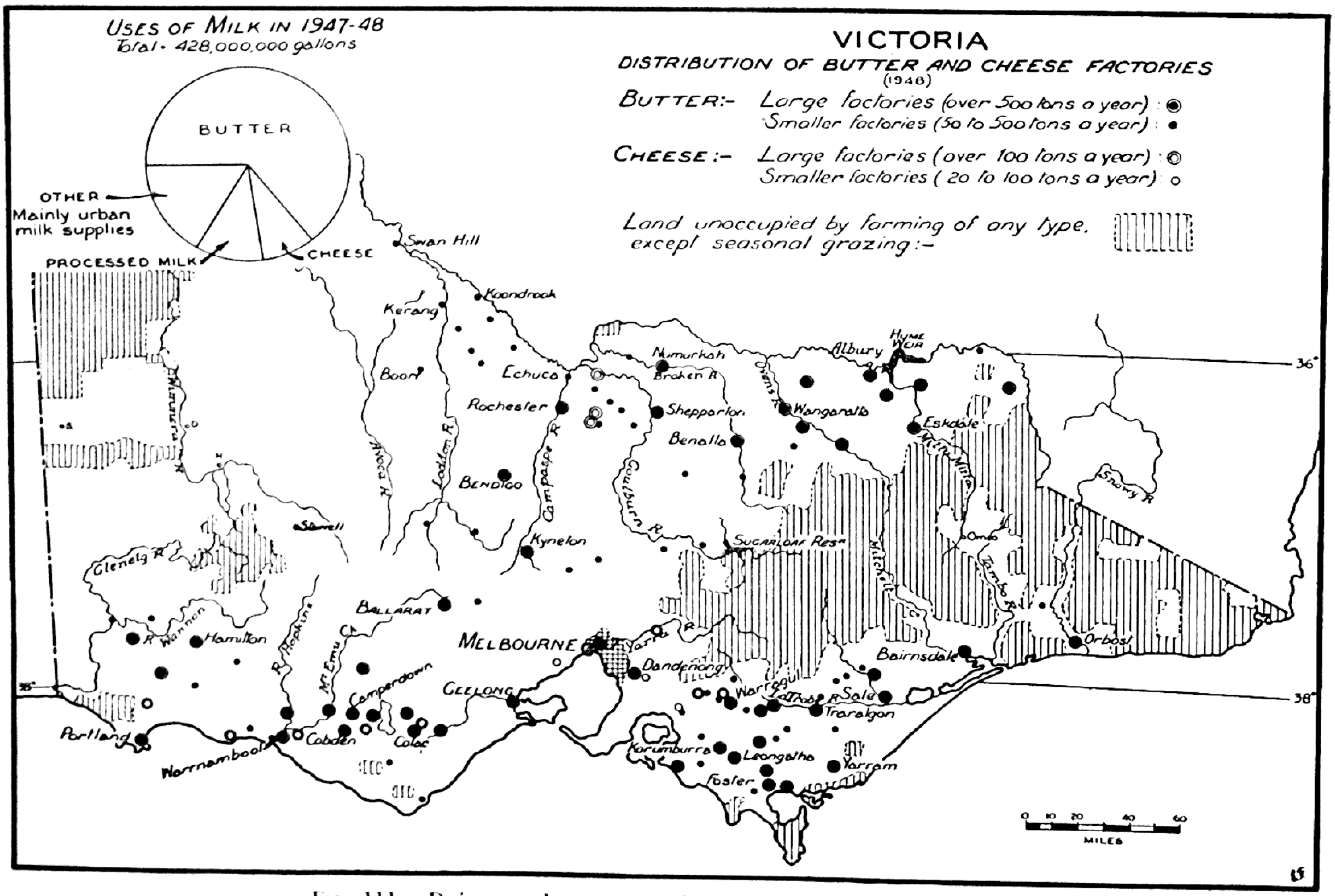

FIG. 111. Dairy products processing factories in Victoria, 1948.

from here. The farming will be noticed as extending into the foothills, which tend to isolate some settlements, e.g., Orbost. The growing of potatoes, maize and oats, together with timber-getting, are associated activities.

3. **Irrigated districts.** Irrigated pastures (perennial rye grass and white clover) for dairying have been developed in some of the northern districts, utilizing waters from the Goulburn and Murray valleys. About Shepparton and Rochester and extending to Swan Hill, the density of cattle is fairly high. Production is for both butter and cheese as well as whole milk for local consumption; the last-named is important for river settlements in the north-west, e.g. Mildura. Fruit-growing, fat lamb raising and lucerne-growing for baled hay are other pursuits of the irrigation districts.

4. **North-eastern districts.** The valleys of such rivers as the Broken, Ovens and Mitta Mitta provide the alluvial soils basic to the dairying industry in the north-east of the State. Figure 111 shows that the larger factories occur, in the main, in district centres, e.g., Benalla and Wangaratta.

5. **Central districts about Melbourne.** Like all capital cities, Melbourne draws its whole milk supply from areas within reasonable transport distance. Dairy farms relatively close to the city account for a considerable amount of the supplies. There are only two large factories within 50 miles of the metropolitan area, although cattle densities range from 20 to over 80 to the square mile in the occupied farmland about it.

Two final points worth noting about Victorian dairying are:

(*a*) The pig-raising industry is closely associated with it in all the districts discussed, the Gippsland area being the most productive.

(*b*) The series of smaller factories scattered through the State, more particularly in the wool-wheat belt, are kept in production by dairy herds which supply local markets where supplementary fodder and water are available.

Sydney's milk supply. Figure 112 is typical of the factors of the fresh milk supply of a large city. It should be studied in conjunction with the material on pages 65 and 66 of *Regions and Men*.

The following points should be noted:

1. The 130,000 gallons of milk used daily in Sydney must be moved in by fast train each day from a wide area.

2. There are three main lines of movement (*a*) from the Hunter and Manning valleys, contributing over 60 per cent of the total; (*b*) from the Illawarra-Nowra district; and (*c*) from the Southern Tablelands as far as Moss Vale.

3. The immediate hinterland of Sydney produces a mere 16 per cent, and even some of that is sent west over the Blue Mountains.

4. The boundary of the Milk Board area includes all areas supplied as well as those forwarding milk to the city, e.g. Newcastle, Wollongong and the Blue Mountains are supplied from the area.

5. Dairies supplying the milk are under rigid supervision by the Milk Board for cleanliness.

6. Milk is collected at appropriately placed depôts throughout the area where it is chilled before being sent to the city. On arrival at the city depôts it is pasteurized before distribution.

Collection and distribution are handled by two large companies, one a co-operative and the other a private company.

7. There has been a marked decline in butter production throughout the Milk Board area, as most of the milk is now sold for human consumption. The few remaining factories (see Figure 106) concentrate mainly on making powdered milk from surplus supplies in flush periods and on butter-making for local markets only.

8. The Board is planning to increase supplies from the Kempsey-Wauchope area, which lies over 300 miles from Sydney.

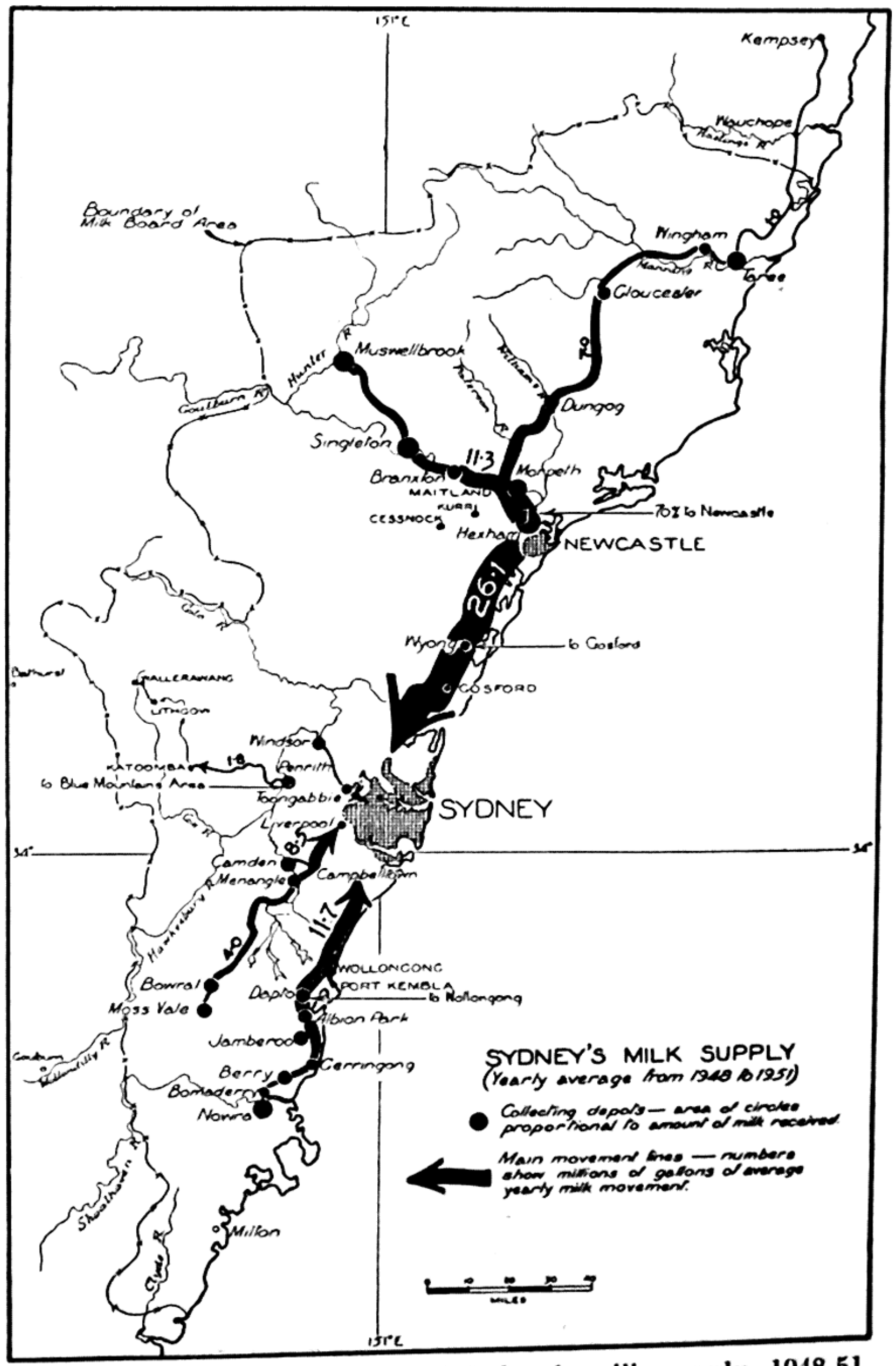

FIG. 112. Diagrammatic map of Sydney's milk supply, 1948-51.

12

SPECIALIZED FARMING: SUGAR IN AUSTRALIA

Specialized farming usually develops where unique conditions of landforms, soils, climate and market demands lead to the intensive farming of special crops. This can best be seen in the case of the sugar farms of north-eastern Australia or the irrigation areas of New South Wales and Victoria, with their concentration on fruits. Other forms are represented by the Murrumbidgee Irrigation Area rice farms and the smaller properties (orchards and market gardens) near urban populations which need regular fresh supplies of fruit, vegetables, poultry and flowers. Studies of cities in *Regions and Men* show how such market gardening depends on the factor of location rather than on other physical needs in order to be successful.

In general, specialized farming can be divided into two broad types, specialized horticulture and commercial plantation crop tillage.

1. Specialized horticulture. This type of farming concentrates on the production of foodstuffs by market gardens and truck gardens. The former, located in and near the urban-rural fringe of cities, may take the form of small properties often with poor soils, but highly developed by much family labour, skilful farming and the widespread use of fertilizers and irrigation. Glass-houses may be built to give early crops which obtain high prices on markets where supplies are short. Good examples of this farming will be seen in the studies of vegetable-growing about Sydney in *Regions and Men*.

Truck gardens may not be so close to cities, but make up for it by exceptionally favourable soils and by the climate, which matures the desired crops earlier than in the market gardens. Irrigation may be possible on a larger scale and the products reach the consumers both in canned form and as fresh crops. A further contrast may be seen in the more extensive use of machinery in the farming routine. Studies in the Murrumbidgee Irrigation Area give a good picture of this type of farming.

In both types the cultural landscape is similar, giving an impression of intensively cultivated fields, few animals (except in the fat lamb country of the Murrumbidgee Irrigation Area) and closely spaced homesteads joined by good roads. Further, they take up only a fraction of the surrounding land and may be set in the centre of grazing, timbered or otherwise unprofitable country.

Commercial fruit-growing may also be included in specialized horticulture. Later studies will show that this type of agriculture is more scattered than other varieties, but may be found in association with them. This is because fruits demand special conditions of slope, soils and elevation and cannot be raised merely in areas which are near markets. The cultural land scape may be similar, but the labour needs are frequently seasonal because of different ripening periods. The special problems of orchardists are maintenance of fertility, soil erosion, replacement of trees and vines, seasonal losses by weather and pests, processing, packing and transport.

2. Plantations. These are a characteristic form of agricultural exploitation of tropical regions by peoples of temperate lands. The essential features are:

(*a*) Large holdings, often several thousands of acres in area.

(*b*) Managerial positions and capital are supplied mostly by European and American individuals and companies.

(*c*) Little machinery is used in most of the agricultural activities and large numbers of coloured peoples may be recruited from China, India, the Philippines and some West Indian islands.

(*d*) This labour force is housed in village settlements, adjoining the offices and factories of the company concerned. Hence the typical settlement pattern is that of several large buildings of that type, with a few high-class European-style homes, together with, perhaps, a hundred or more small huts near by. These huts are usually surrounded by small cultivated plots of cereals, vegetables and fruits, since the native labourers get much of their food supply by traditional subsistence farming methods.

(*e*) Most plantations have processing units attached to them and they also maintain research staffs for improvement of crop types and the control of pests.

(*f*) Some of the more important crops produced by plantation agriculture are, sugar-cane, oil palm, coconuts, fibres (manila and abaca), pineapples, bananas (especially in the Caribbean area), rubber, tea, coffee, cocoa and cinchona.

Sugar-growing regions of the world (Figure 113). The world supply of sugar is derived from two main sources, sugar-cane and sugar beet. There is also a small amount of maple sugar in America. Sugar-cane is a tropical and sub-tropical crop, sugar beet a moist cool temperate one grown almost exclusively in the northern hemi-

sphere. Note the boundary line between the two and the relative production on the bar graphs.

Sugar-cane. 1. Sugar-cane is a giant perennial grass with stalks ranging from one to one and a half inches in diameter and up to twelve feet in length; its exact origin is obscure, but it undoubtedly had its beginnings in the Indo-Malayan region. The conditions which suit it best are an annual rainfall of the monsoon type of from 60 to 150 inches with high temperatures and humidity. Little growth will take place below 75°F. It is normally harvested in the winter, spring and early summer months when drier conditions obtain. Although it thrives on rich loamy

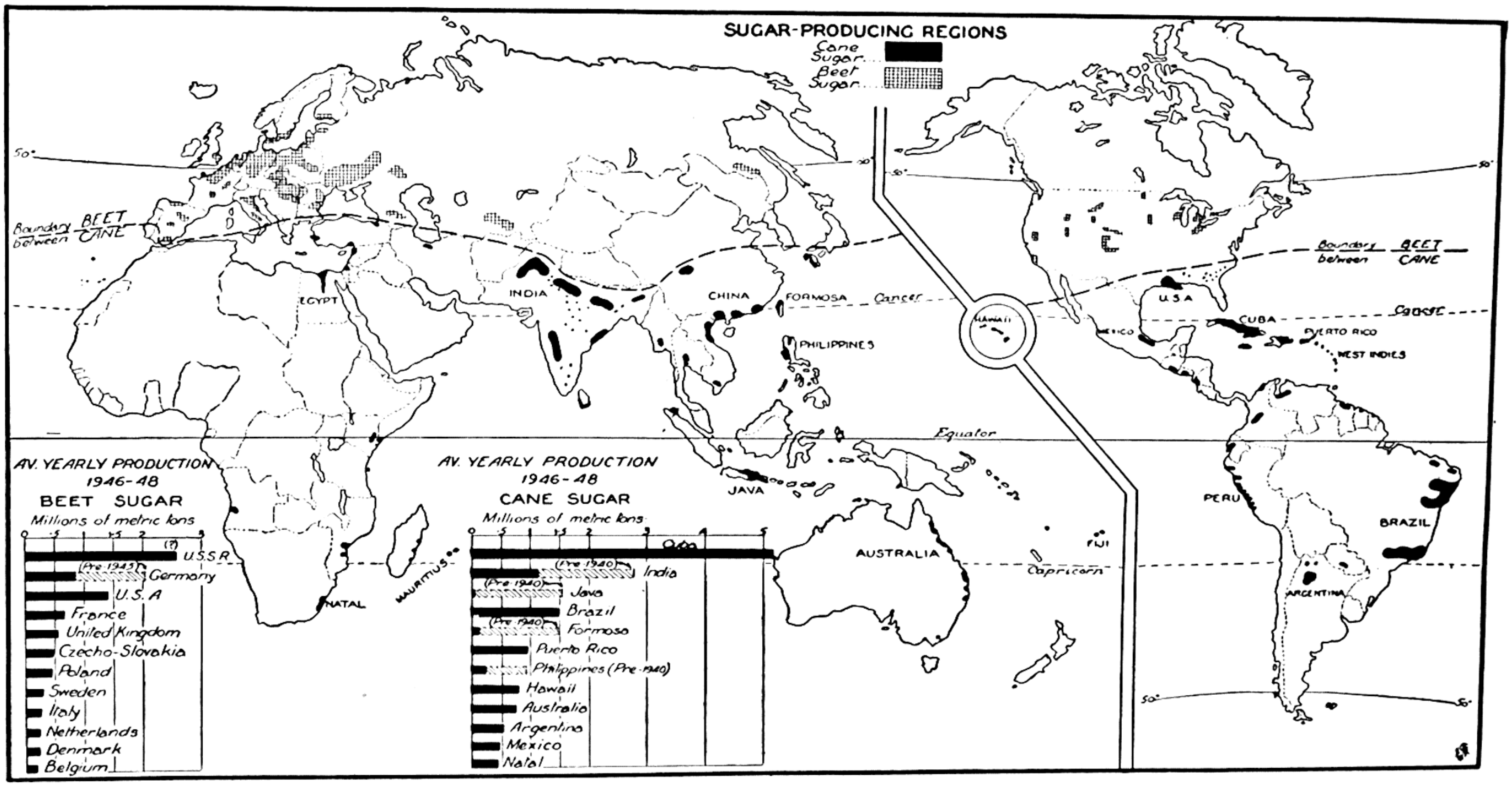

FIG. 113. World distribution of cane and beet sugar.

soils it is particularly adaptable to soil conditions and much of the world's sugar-producing land consists of heavy clay loams. The crop is a gross feeder, necessitating generous use of fertilizers and the growing of legumes in the rotation.

Planting is carried out with cuttings from the stalks, these being about twelve inches in length and having three or four eyes. After harvesting the crop the underground stubble is capable of producing a "ratoon" crop which eventually is succeeded by a second "ratoon". Three crops from one planting make the normal cycle. The cane is generally harvested manually, being cut down level with the ground and the top severed by heavy cane knives or machetes. Mechanization is replacing the laborious hand cutting particularly in Louisiana, Hawaii and parts of Queensland.

Mills capable of crushing up to half a million tons of cane in a season are located in each district and at these the juice is extracted and the raw sugar manufactured. Molasses, one by-product, is used for various purposes but principally in distilleries, while bagasse, the cane fibre, supplies all the fuel required for the mills' boilers with any excess diverted to fibre board production. Refining of the raw sugar is sometimes carried out in the same factory, but in Australia the raw crystalline product is refined in the capital cities.

2. This is usually a crop produced by coloured labour, the only exception being found in Queensland. Three types of farming are associated with the growing of cane (these should be checked on the map):

(*a*) Plantation agriculture in Java, Hawaii, Philippines, West Indies, Formosa, Fiji, Natal, Brazil, Mauritius, Florida and Louisiana.

(*b*) Sugar farms in subsistence areas of Egypt, India, China, Java, Peru, Fiji, the West Indies, Puerto Rico and Louisiana.

(*c*) Individualistic farms run by white labour in Queensland.

Beet Sugar. 1. This is mainly a product of three areas: western Europe, the U.S.S.R. and the United States.

The sugar is derived from the root of the sugar beet, a large, coarse member of the beet family which has long been used as animal fodder along with mangolds and turnips. Though the manufacture of beet sugar was started in the time of Napoleon I, its general use is mainly a development of the last hundred years. Its production was encouraged by American and European governments desiring to free their countries from dependence on imported sugar supplies, which were mostly costly and often erratic.

2. At first the growth of sugar beet and the production of beet sugar were heavily subsidized by Governments. To-day, more efficient farming and processing methods have practically eliminated the payment of cash subsidies, though import restrictions on cane sugar still exist in most sugar beet producing countries.

3. Sugar beet needs a five months' growing period with long moderately warm sunny days for most of this time. The growing season extends from spring to autumn and rainfall then needs to be moderate and well distributed. Irrigation is often used, especially in America. Soils must be fertile, sandy loams carefully prepared. Cheap, unskilled labour is necessary for weeding and cultivating, so that women and children do much of the work in the fields. In the United States and England, however, the industry is now highly mechanized and practically all hand operations have been replaced by mechanical methods.

4. Factories slice up the beets and extract the juices, which are then concentrated and purified in much the same manner as with cane sugar. The tops and leaves are left in the fields for stock feed or used in later cultivation. The pulp remaining after the juice extraction is dried and disposed of as stock feed.

5. Beet forms a useful crop in the farming rotation of western European agriculture.

Graphs of production. The graphs on Figure 113 show the relative production of both beet and cane sugar. Where World War II has caused considerable variations from pre-war production, the pre-war amount is indicated. Points to be stressed are:

(*a*) The total production of cane sugar is somewhat greater than that of beet sugar. Both amounts fluctuate widely owing to seasonal and price variations.

(*b*) Cuba and India (normal conditions) are dominant in cane sugar; U.S.S.R. and the United States in beet sugar.

(*c*) There is considerable import of cane sugar by western Europe, Canada and the United States (which absorbs nearly all the output from Cuba, Hawaii and the Philippines). Smaller amounts move into Japan and India.

(*d*) There is practically no export of beet sugar beyond some interchange among European producers and nearby non-producers.

The growing of sugar in Australia (Figures 114 and 115). Factors of importance in the industry. 1. In its development the industry in Queensland and northern New South Wales has passed through several phases, starting with the purely experimental. Then there followed the customary pattern of plantations employing imported coloured labour (Kanakas). Indenture of these ceased by 1900 and sugar production languished during a long and troublesome period of transition to white labour conditions. Commonwealth Government aid during World War I, when Australia was forced to accelerate production for local and oversea consumption, did much to stimulate the revival of the industry. This help took the form of a bounty obtained by fixing the Australian price of sugar well above that of world parity price, i.e. 4d. as against $2\frac{1}{2}$d. a pound. This enabled white labour at high wages to be employed for planting and, more especially, for cutting the cane. The increase in the efficiency of the sugar industry under white labour has been the outstanding achievement of Australian tropical agriculture. This has been accomplished largely by scientific and technical research and its application to farm and mill practice.

2. Geographic factors affecting the sugar industry.

(*a*) The main factors are temperature and rainfall.

(*i*) Sugar is mostly a 10 to 15 months' crop and cannot withstand severe frost, so that the 12 months frost-free areas are the best. That is why 80 per cent of sugar is now produced from Mackay to Mossman and 40 per cent north of Townsville.

(*ii*) Where rainfall is not over 60 inches per annum with at least $2\frac{1}{2}$ inches in the driest months, conditions are less favourable and supplementary irrigation is desirable. Note the position of the isohyets on Figure 114.

(*iii*) Irrigation is practised on all farms at Ayr, where the annual rainfall is 43 inches and to a lesser extent at Bundaberg, which has a similar rainfall.

(*b*) Soils are an important factor but less so than the climatic ones. Heavy fertilizing is common with sulphate of ammonia, superphosphate and potash; molasses, which is rich in potash and nitrogen, is also used to a limited extent. The main soils are alluvial flats along the lower courses of coastal rivers, volcanic loams and forest sandy loams of ancient marine origin.

(*c*) Landforms exert a strong localizing influence, as the cane is grown only on the river flats or lowland undulating country near by.

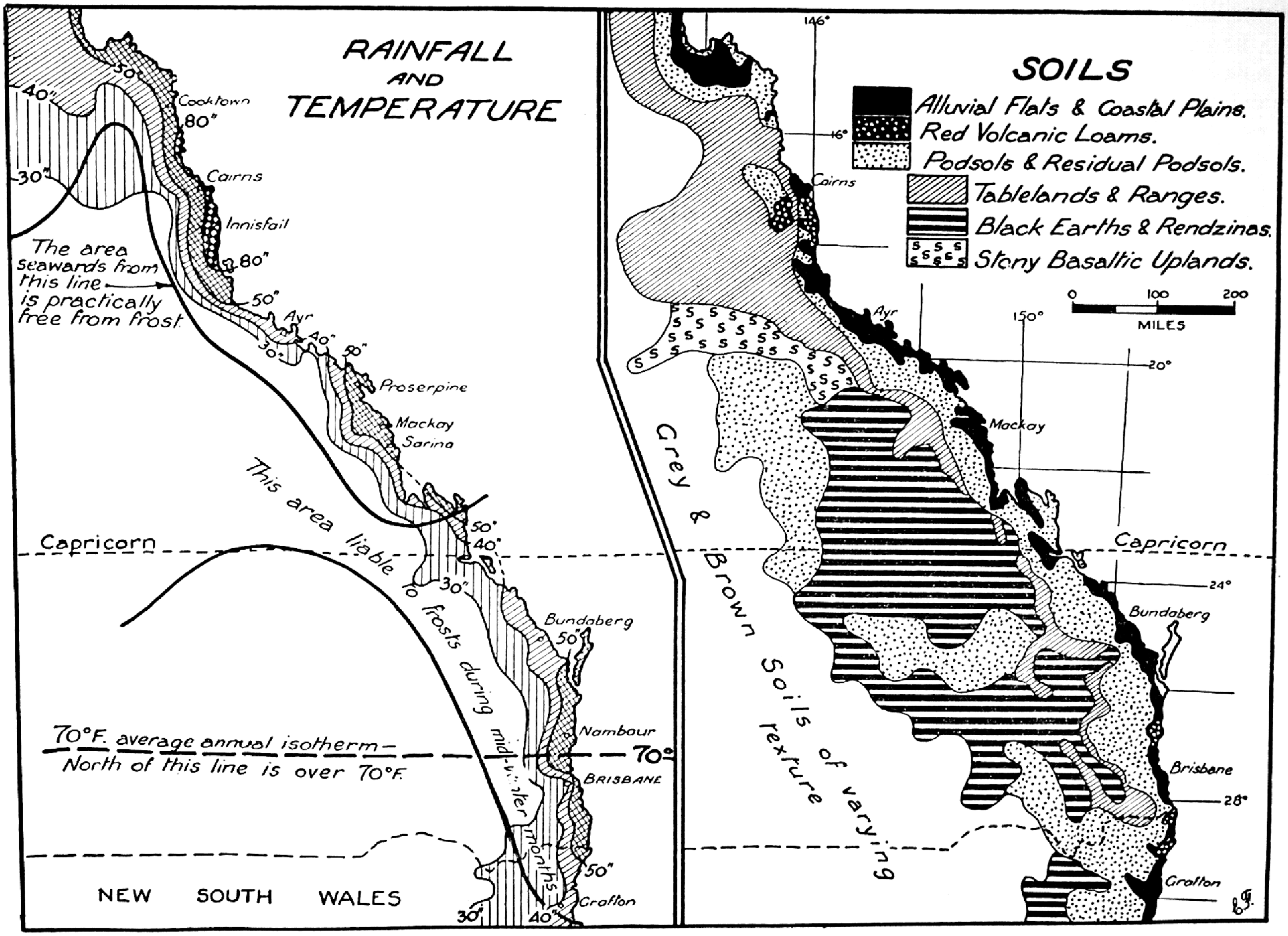

FIG. 114. Some controls of sugar-cane growing in Queensland.

(*d*) Man-made factors are also of great significance in the industry.

(*i*) The location of the mills with their radiating light railways determines the actual land cultivated in any area. The need for quick transport to mills after cutting necessitates farms being close to lines coming from the mills. Because of this factor an appreciable acreage of suitable land is still unused.

(*ii*) During the late 1920s, when over-production resulted in exporting the surplus on the world market at very low prices, restrictive measures were introduced. The principal one was the assignment system, under which each grower was allotted a maximum acreage for annual harvest. Such acreage is not subject to periodic amendment, although during the recent expansion of the industry, assigned areas have in many cases been increased. To-day assignment is the keystone of sugar cultivation. The farmer is limited both in area and location of his cane land. The result of this has been a growth of one-crop farming.

(*iii*) All operations associated with land preparation, planting, fertilizing and subsequent cultivation, including weed control, are highly mechanized. In this respect the Queensland sugar industry has led the sugar world for 50 years. Mechanical harvesting and loading are not yet universally employed.

(*iv*) In north Queensland there is a four-year rotation system, viz., one first crop, two ratoons, legume, then replanting of sugar.

Sugar mills and refineries (Figure 115). As noted above, the sugar-cane industry is based on a series of central mills and this map shows their location in relation to the actual cane-growing areas they serve.

Fifteen of the mills are controlled co-operatively by the growers, the balance being owned by private com-

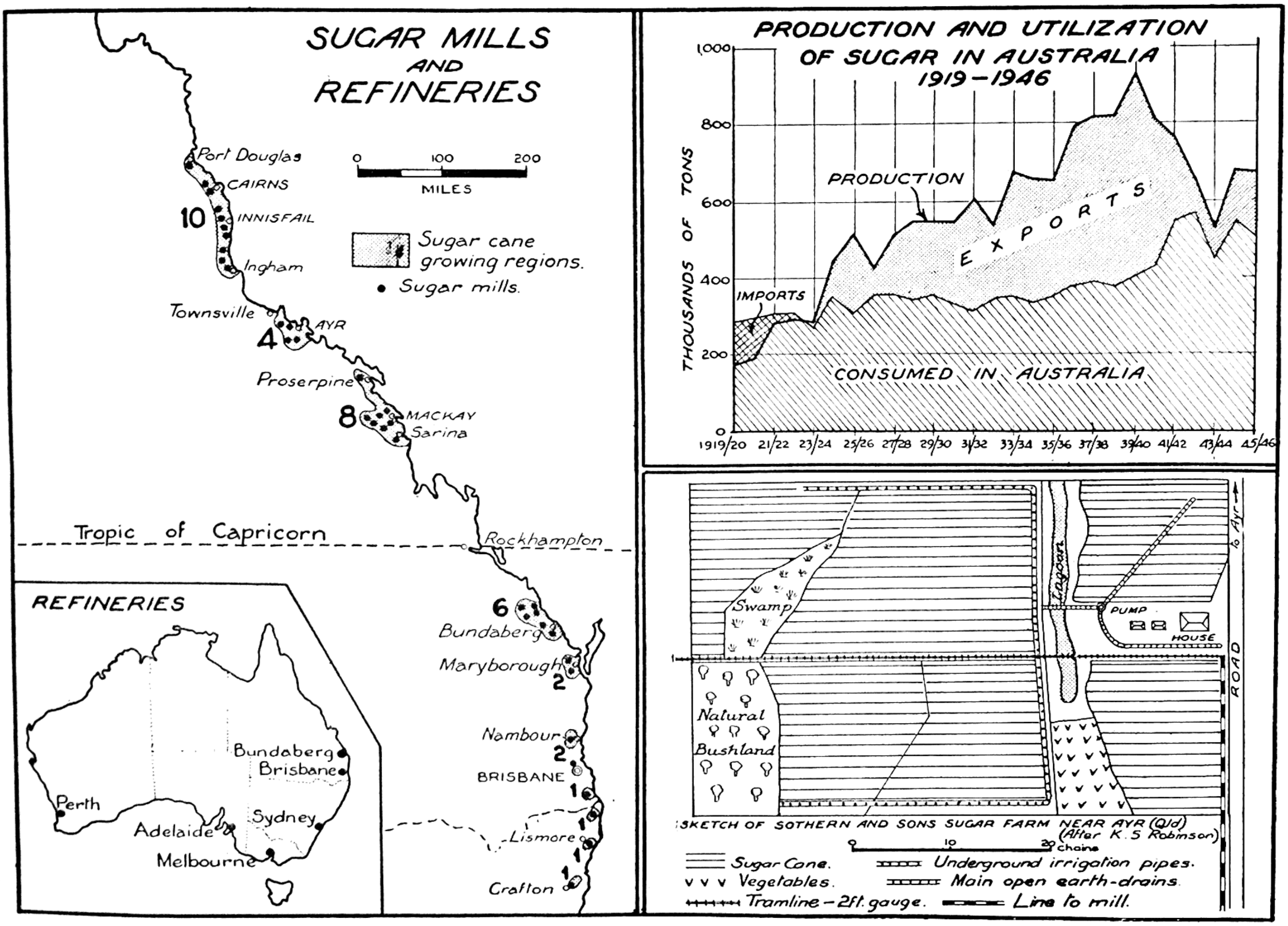

FIG. 115. A summary of various aspects of sugar production in Australia (*Farm plan by courtesy of K. S. Robinson*).

panies. Each mill has assigned to it the cane grown on a particular area. In turn the mills assign groups of cutters to groups of farmers in rotation, to supply a daily quota to the mill. This system has developed as an accessory to individual farm ownership and production.

The function of the mills is first to crush the cane and boil the juice extracted—a highly skilful task which eventually produces raw sugar and the by-products of molasses and bagasse (cane fibre). These latter products may pass to special factories for further treatment (e.g., industrial alcohol and rum from molasses and caneite boards from bagasse). The sugar goes on to the refineries, where white and special grain varieties are made. Other refinery products include golden syrup and treacle.

Except for the one at Bundaberg, the refineries are all situated in the major population aggregations of capital cities. This is because they are the main markets for sugar and the different by-products. Such centres also supply the skilled labour needed in refineries.

Farm routine. Before describing the cultural landscape of a sugar-cane farm it is well to note the general farm routine.

(*a*) In the farmlands where the property has been established for some years after the initial clearing and burning-off of the forest, the canefields are ploughed and cultivated carefully. This may involve the turning-in of the leaves and old roots of a previous crop or of a legume like cowpeas. In the final steps, deep planting furrows are put in.

(*b*) The planting is by machinery and consists of the sowing and covering of the short cuttings from cane stalks. Manure in the form of superphosphate, potash and sulphate of ammonia is placed in the rows at the same time as the cuttings. Roots come in a short time from around the joints on the stalk and the buds on the joints sprout into young cane shoots.

Later, more shoots grow from the base of the original shoot to form a clump of stalks.

(*c*) While the cane is young the farmer keeps up an intensive cultivation. In this way weeds are kept down, growth stimulated and the furrows filled in completely. After three or four months the cane is tall enough to shade the ground between the rows and smother weed growth. Cultivation then ceases. Many farmers now use hormone weedicides to kill weeds.

(*d*) Although most Australian cane matures in from 10 to 15 months, full growth may take anything up to two years in the areas south from Maryborough. When ready the cane is cut, usually by hand, stripped of leaves and loaded on drays or motor trucks which haul it off to mill sidings, from which light 2-foot gauge railways run to the mills. There are about 2,000 miles of these light railways throughout the sugar-growing areas.

(*e*) In most cases the cane is burnt off before cutting. This makes the cutting quicker, though much dirtier. If burnt, the cane must be taken to the mill within 24 hours, as the heating from the fires causes the juice to ferment.

(*f*) If the farmer leaves the stubble in the ground he will get a second (or ratoon) crop without replanting. This is possible with any variety of cane and it is normal to grow two such ratoon crops. Where ratoon crops are grown additional fertilization is necessary.

A typical sugar-cane farm. Bearing the foregoing in mind, it is possible to understand the way in which the farm shown in Figure 115 operates. It is a property of some 200 acres, 190 of which are canefields, situated near Ayr on the flat, delta lands of the Burdekin River. Here there are heavy brown loam soils and satisfactory temperature conditions. The rainfall is insufficient, since only 43 inches a year fall, mainly in the months of January, February and March. As a result there may be no moisture for periods of up to six months and the farmers have to irrigate.

(*a*) The lowland nature of the property is indicated by the presence of a lagoon and a swamp.

(*b*) There are underground irrigation pipes, a pump and open earth drains. This is because, following planting in April and May, the sugar has to be watered every fortnight until December, when the rains come.

(*c*) There is some vegetable cultivation in addition to the growing of the cane.

(*d*) Apart from the homestead, there are sheds which house fertilizer and machinery, because this farm is highly mechanized for ploughing and seed-bed preparation, planting, cultivation and weeding. Tractors also do much of the haulage work.

(*e*) There are several light train lines which carry the cane, harvested from June to November, to the mill siding, where small engines pull the loaded trucks to the mill.

(*f*) The property is worked by two brothers, who employ two permanent workers and engage hired labour at cutting periods and when planting.

(*g*) The cane on this farm is ratooned after cutting and after this crop is harvested the following year the ground is allowed to lie fallow for a season.

(*h*) The weight of cane per acre on this farm is from 40 to 50 tons for the original crop and 30 to 40 tons for the ratoon crop. This is somewhat higher than normal because of the very rich soil and the controlled watering.

13

COTTON IN THE UNITED STATES

Introduction: Cotton growing regions of the world. Cotton is the most important fibre in the world, with a production exceeding the combined total of all other commercial fibres like silk, wool, flax and rayon. This is mainly because it has such a wide range of uses. The good producing areas are concentrated in relatively few countries and the major manufacturing centres are frequently far from these, e.g., United States, and Europe.

Raw cotton consists of the fibres which grow on a special kind of seed. The length of the fibres is known as the "staple". This size is very important because the greater the length of each fibre the greater will be the overlap in spinning the threads and hence the thread will unravel less easily and be stronger. Most cotton in the trade is of "medium" staple and varies from $\frac{3}{4}$ inch to $1\frac{1}{8}$ inches. It is used for all ordinary clothing and sheeting. Long staples are over $1\frac{1}{8}$ inches and up to two inches and are in demand for the production of the finest materials, e.g., lawn. By contrast, short staple cotton is less than $\frac{3}{4}$ inch in length and makes up into coarse materials, e.g., dungarees. Different varieties of cotton are associated with these staples and are closely adjusted to special soil and climatic requirements. As a result they cannot be planted at random in any cotton region.

Figure 116 shows that the range of cotton is wide, being from 30° south to 50° north. This suggests many different types of plants because within such a range climatic and soil conditions would vary considerably. The main areas, with the exception of the U.S.S.R., are in or near the tropics. This is partly because the original plant was a perennial which developed in a tropical savanna climate. Although commercial varieties are grown outside these latitudes to-day, many of the major producing areas still require:

(*a*) A marked seasonal rainfall—summer maximum—so spread as to give light moisture when there is planting and heavier when growing;

(*b*) a drier season following to keep bolls clean and permit picking;

(*c*) a high summer temperature and humidity;

(*d*) a frost-free period of at least 200 days.

If rainfall is low but temperature sufficiently high

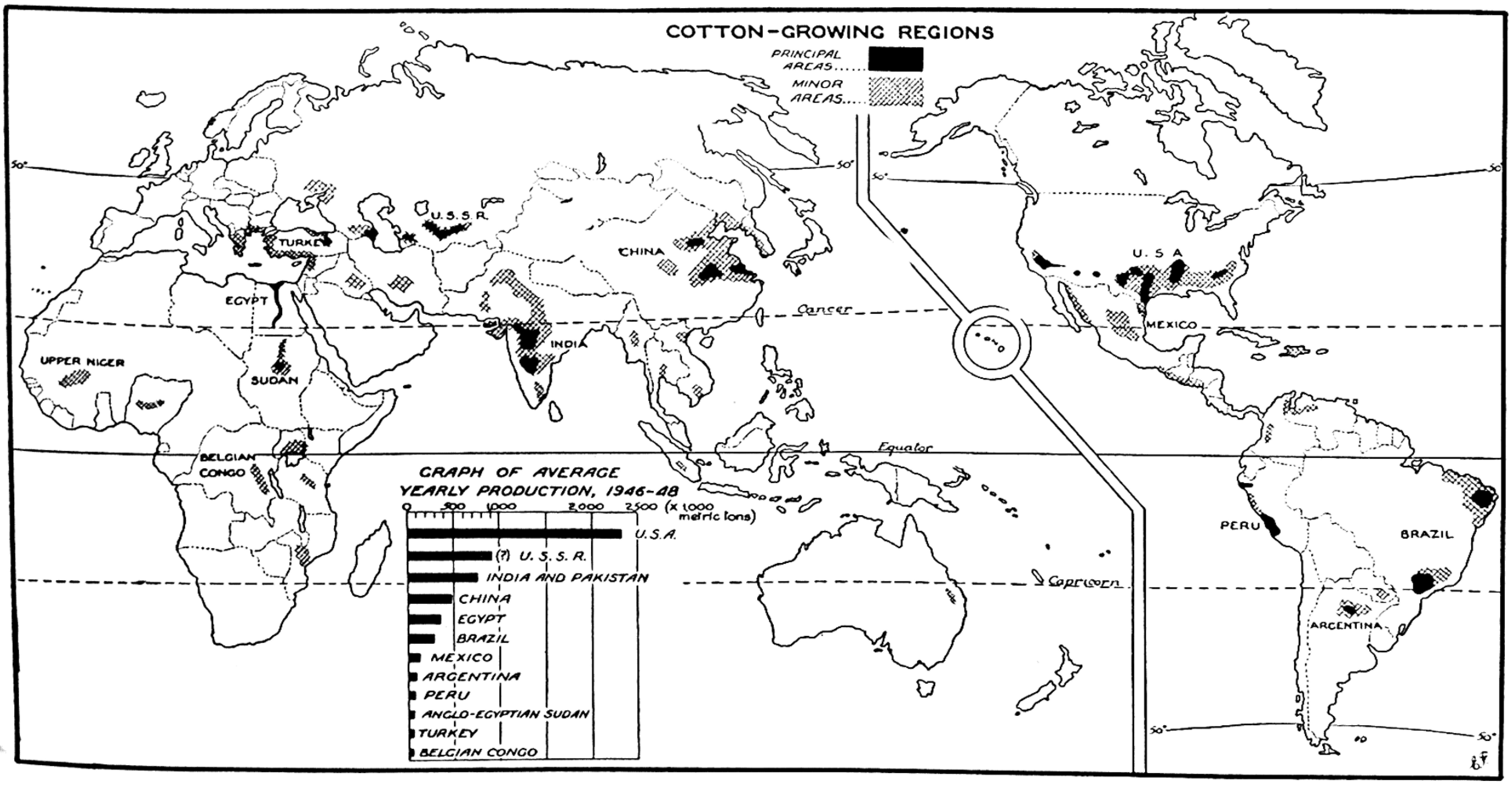

Fig. 116. Distribution of cotton-growing areas throughout the world.

for the right length of time, irrigation may be used to supply the necessary moisture as in Egypt or southern California.

Good fibre can be produced on a variety of soils, but generally they need to be fertile (or heavily fertilized) and well drained. For this reason alluvials are the best. Soil conservation is a major problem, since fields of fine soils are often located on rolling lands, the plant is a heavy feeder, and leaching is common in tropical regions. Careful farming methods are also needed to prevent sheet and gully erosion.

Commercial cultivation of cotton usually needs much hand labour and hence the special significance of negro slaves in the early United States fields. In tropical countries a large native population can supply the hands needed. Machinery is now becoming important and is displacing many of the purely manual tasks.

The plant is subject to certain pests and diseases, of which the boll weevil is the most serious. Farmers, with the aid of science, can now control these in large measure.

1. Medium staple cottons are to be found largely in:

(*a*) the United States, where more than half the world's total is raised on coastal and river plains and rolling prairies (Figure 117) of the south;

(*b*) parts of Brazil, where methods and quality are like those of the United States;

(*c*) parts of the U.S.S.R., where there has been great expansion due to domestic demands and the use of irrigation in Turkestan.

2. Short staple cottons appear principally in:

(*a*) India and Pakistan, where the fibre has been grown for thousands of years, mainly on the famous "regur" soils of the Deccan, for peasant clothing, although better qualities are coming from irrigated lands, e.g., Indus valley;

(*b*) China, where cotton has flourished for centuries on the river valley and loess soils of central and northern regions and where main competition has come from food crops; full peasant demands are met by imports from India.

3. A small production of long staple cotton from:

(*a*) Egypt, where small farms, ideal soils and climatic conditions, plus use of irrigation give the finest qualities;

(*b*) California, Arizona and New Mexico where large scale, scientific, mechanized cultivation has outstripped other parts of the United States.

(*c*) Some West Indian islands.

Expansion in Brazil. Although the north-eastern areas of Brazil have produced only medium quality cotton for many years because of uncertain rain and the cultivation of perennial varieties of plants, the last few years have seen a rapid expansion in the central plateau. This can be attributed to favourable physical factors, the availability of old coffee fazenda and virgin lands, an immigrant population and the adoption of American varieties of cotton and large-scale methods of farming. A glance at the graph on Figure 116 will show the relative status of Brazil's production, which promises to challenge that of the older exporters.

The use of irrigation in Egypt, Peru and western United States. In Egypt and Peru artificial watering of the cotton crop has been the practice for many years. Both produce a high yield per acre of the long staple variety on river alluvials by using intensive methods. Peruvian fields are much larger but their expansion is prevented by the limited water supply available. The marketing of the Egyptian crop is highly organized on an excellent transport network of river, road, rail and canal.

The appearance of irrigated cotton lands in western United States is relatively new and associated with a number of factors dealt with later (Figures 117, 118, 120). It is fast becoming one of the most important crops in the west, especially in California, and is replacing many areas of the traditional south in the American cotton-growing economy. Not the least important feature is the development of cotton along with the vast Federal irrigation projects for the arid and semi-arid regions of the country. On the other hand the great T.V.A. scheme will help to rehabilitate many former cotton farmlands of the east by directing them to greater diversification of agriculture.

Export movement. The United States dominates the field and together with Brazil, Peru and Egypt (there is a keen demand for the fine quality of the last two) is responsible for considerable movement to the manufacturing areas of Europe and Japan. Much also goes from India to eastern Asia. Home consumption is the aim of several countries, e.g., the U.S.S.R. and China. The future of the world trade is bound up with expansion of the industry in Brazil and central and eastern Africa, where conditions are highly favourable to the commercial production of the good quality cotton which a world of advancing technological processes needs more and more.

Cotton growing in United States. (Figures 117 and 118). The cotton lands of the United States produce about half the world's output. In order to see both the distribution of these fibre-growing areas and the major factors which help to determine their particular location, it is necessary to study Figures 117 and 118 together. Although the crop is grown throughout the whole of the southern States, its cultivation is confined essentially to the so-called "cotton belt" stretching from the Atlantic coast to western Texas. The importance of producing regions outside this belt, the upper Rio Grande, Salt River and San Joaquin

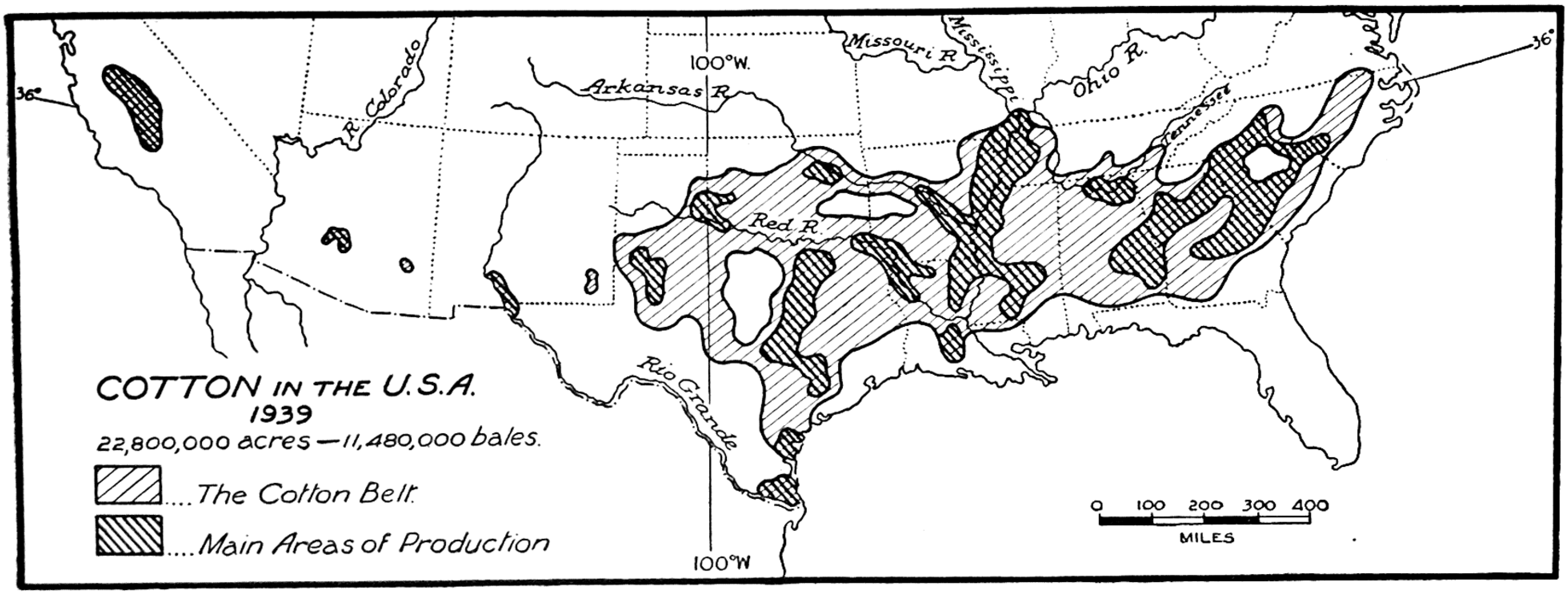

Fig. 117. Distribution of cotton-growing in the United States (*After Department of Agriculture, U.S.A.*).

Valley of California, lies in their use of irrigation to offset climatic handicaps, their freedom from the boll weevil, and their evolution of special types of fine, long-stapled cotton. In recent years their acreage has increased and mechanization at all stages of the farming economy become common (see Figure 95). They are responsible for about 10 per cent of the American crop.

While there are still some very large estates in the older lands of the south organized along lines similar to those followed in tropical plantations with an abundance of hired labour to perform all the work, most of the farms there are relatively small and are worked by owners or tenants and their families. In addition to the major crop, many farms, but not all of them, also grow the bulk of their requirements of vegetables, corn, and fruits. By contrast the larger farms in the newer areas of the west are worked by machinery with very little subsistence activity. Cotton-growing in the United States is a combination of cash crop and subsistence farming. The particular geographic significance of this will be discussed more fully in connection with Figure 121.

The main geographic factors responsible for location and specialized agricultural activities of cotton cultivation include:

1. **Landforms.** Cotton crops grow wholly on level

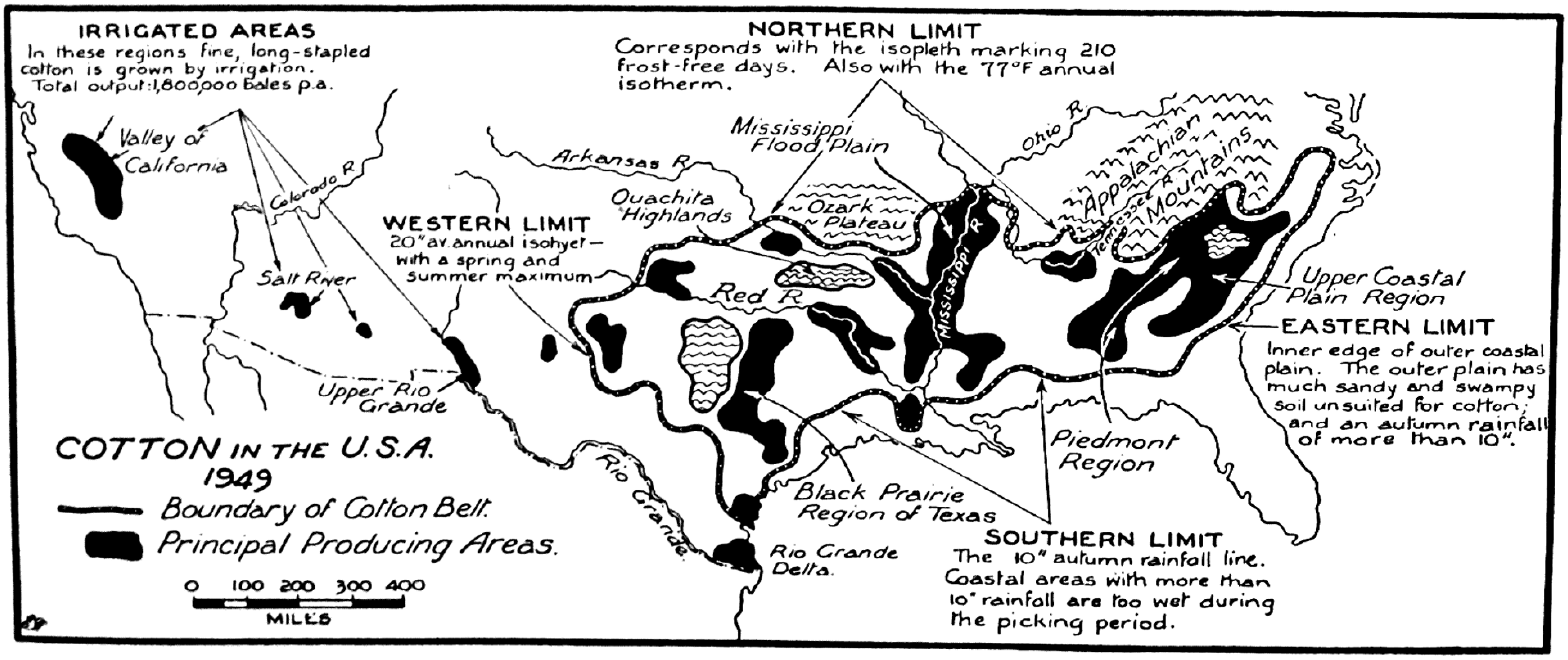

Fig. 118. Some geographic factors affecting the cotton belt of the United States.

or slightly undulating lowland or plateau landforms. They occupy the southern part of the Mississippi basin, part of the Atlantic Coast Plain, and certain valleys of the western uplands. Figure 118 shows also that three relatively old highland masses project southwards into the cotton regions, i.e., the Appalachian Mountains, the Ozark Plateau and the Ouachita Highlands. Obviously they do not figure in any production.

2. **Soils.** Cotton is a crop of the valley floor, the river flood plain or rolling prairie grasslands. It is in such areas that we find sandy, loamy or alluvial soils which are deep, fertile, well drained and easily worked for cotton growth. Because of these very qualities and bad farming practice over a long period of years they are literally the scene of the worst erosion in the whole of North America. Several soil types occur throughout the cotton belt, but farming is most intensive on the following:

(*a*) The dark brown soils of western Texas and the black varieties of the centre of that State. Both are very fertile and easily cultivated and their location on fairly flat lands with a relatively lower rainfall than elsewhere has minimized the erosion problem.

(*b*) The loess soils on the uplands east of the lower Mississippi where rich, fine silts have been badly affected by bad farming and erosion control.

(*c*) The alluvials built up by deposits from the upper reaches of the Mississippi, Arkansas, Tennessee and Red rivers. Their depth and fertility are maintained by periodic floodings.

(*d*) The sandy loams and clays of the eastern areas about the coastal plain and piedmont country. Although not really rich, cotton-growing has been sustained on them by fertilizers, location near the textile plants and the historic factor of early settlements. (Altogether these soils are not as fertile as those of the corn and wheat belts and must sustain heavy demands with a crop like cotton. Failure to realize this has led to exhaustion in many eastern fields.)

A band of sandy, timbered and swampy country runs from Virginia to the Rio Grande delta, with soil types and rainfall which alienate cotton from the littoral.

3. **Climate.** (*a*) Frost. Since cotton is really a subtropical fibre plant it must be free from hard frosts for a long enough period to enable it to develop its bolls. This period is generally recognized as 210 days and so on the map the northern limit of the belt is shown as corresponding with the frost-free isopleth for that length of time. It is also approximately the position of the 77°F. summer isotherm, since the plant requires heat in its growing period.

(*b*) Rainfall. Cotton also demands a definite amount of rainfall and although it varies from 35 inches in the best areas of Texas to 50 inches or more in the central and eastern farmlands of the belt, it is the seasonal occurrence which is important. The crop likes plenty of moisture in its early growing season in the form of frequent showers with hot sunny periods between, as with the summer months. The picking season is in autumn, which must be dry. Hence the special significance of the southern and eastern limit, being the 10-inch autumn isohyet. More than the 10 inches at this period, plus heat, can damage the lint, interfere with the harvest, and in the south encourages the growth of the boll weevil pest. The western boundary is roughly the 20-inch average annual isohyet. But the soils must be right and an adequate rainfall of the right type must occur in the spring and summer periods. Irrigated crops are not subject to all these conditions, especially since the water can be applied when so desired. But in all cases a dry sunny autumn is a necessity when the cotton has ripened and is ready to be picked. It is worth noting that where the narrow coastal belt has over a 10-inch autumn rainfall, the farming is devoted to rice and sugar in the south and peanuts in the south-east (see Figure 121).

There are two other factors associated with the cotton belt economy which are not indicated on the maps but which are of sufficient importance to warrant a special mention here. These are the labour force and transport facilities.

4. **Labour.** The labour supply has never been a problem in the cotton-growing industry. In its early stages African negroes were brought in as slave labour on the plantations. Their numbers increased greatly and so provided cheap and abundant labour. The situation has undergone a change, with the coloured man recognizing his rights and seeking the same treatment and help as given to fellow-countrymen. This is in spite of the high percentage of tenant farming in the belt (see Figure 122). In addition, many whites have undertaken this form of farming in the western areas and have introduced greater mechanization. For example, although hand picking is the usual method of harvesting, a machine has been invented to do this particular job and has been used with such success in Oklahoma and north-west Texas as to become increasingly popular elsewhere.

The increasing diversity of farming (Figure 121) and the growth of secondary and tertiary industry has absorbed the surplus of labour, as it becomes necessary.

5. **Transport.** This factor has never been a major problem of the cotton belt, due largely to the favourable topography and the number of navigable streams located within it. Although there is a large-scale use of river transport, road and rail share in the movement of the cotton bales and the various by-products from the processing of the raw fibre. Generally this movement takes a sequence pattern of:

(*a*) the raw cotton going from the fields to the

"gin" where the seed is extracted and the cotton pressed into bales of about 500 lb. each;

(*b*) the seed being sent to an oil mill where it is crushed and the oil extracted, one ton of seed yielding 40 gallons of oil. (This is used as a substitute for olive oil and a base for soaps while other by-products from the seed include linters for felt, paper and rayon, and cake for stock feed and fertilizers.)

(*c*) The cotton bales being transported to the markets and export cities on the Atlantic and Gulf seaboards, e.g. Galveston, Houston and New Orleans, with Charleston and Savannah not so important nowadays;

(*d*) distribution from such centres as these to the textile industries of the United States and overseas.

In the case of the far western areas, there is considerable rail movement from the fields of the interior. Sea transport is then *via* the Panama Canal eastwards. Further reference to Figure 123 will show both this and the above-mentioned movements.

Approximate progression of sowing dates (Figure 119 (a)). This map shows how cotton, as a plant extremely sensitive to frosts, can be planted in the various areas of the belt only as the risk of frost disappears with the onset of warmer weather from the south. Hence the sowing, beginning about the Rio Grande and Texas in early March, goes on for a period of almost two months before the whole of the belt is under crop. There is always a risk of late frosts causing such damage to young plants that they must be completely replanted or made good by seasonal production of associated crops in the same districts.

The spread of the boll weevil through the cotton belt (Figure 119 (b)). The boll weevil is a small beetle which ruins the fibre by eating into the unripe pods of cotton. It first appeared in Texas in 1892, coming from the Rio Grande region. Aided by favourable climatic circumstances, it infected, in the space of thirty years, the whole belt as shown on the map (Figure 119 (b)). The result was a loss of up to half on the entire crop of the south. Many farmers were ruined before the agricultural authorities were able to cope with it by burning off, ploughing in and using chemicals. In the last-named a form of dusting by hand was resorted to, but a popular method adopted in the past twenty years is the spraying of the fields from the air.

These were immediate controls to stem damage by the weevil, but over the years certain important long-term effects have resulted.

(*a*) There was a movement of cultivation north and west of the older affected fields so that frost and drier rainfall conditions could kill off the insect in the early stages of its growth.

(*b*) Other types of cotton were bred to ripen quickly and resist the weevil.

(*c*) There were fundamental changes in farming practice so that there was a turning from one-crop farming to the growing of other crops apart from or in association with cotton (see Figure 121).

Although in its ravages the boll weevil caused millions of dollars damage, it created an agricultural revolution which has been of great benefit in farming economy in the cotton belt.

Cotton production by States (Figure 120). 1. The old area. This is located mainly eastwards of the Mississippi and is the traditional "deep south". It was the scene of early plantation farming with slave labour. Following emancipation, it became an area of tenant growers, eking out a precarious existence on a one-

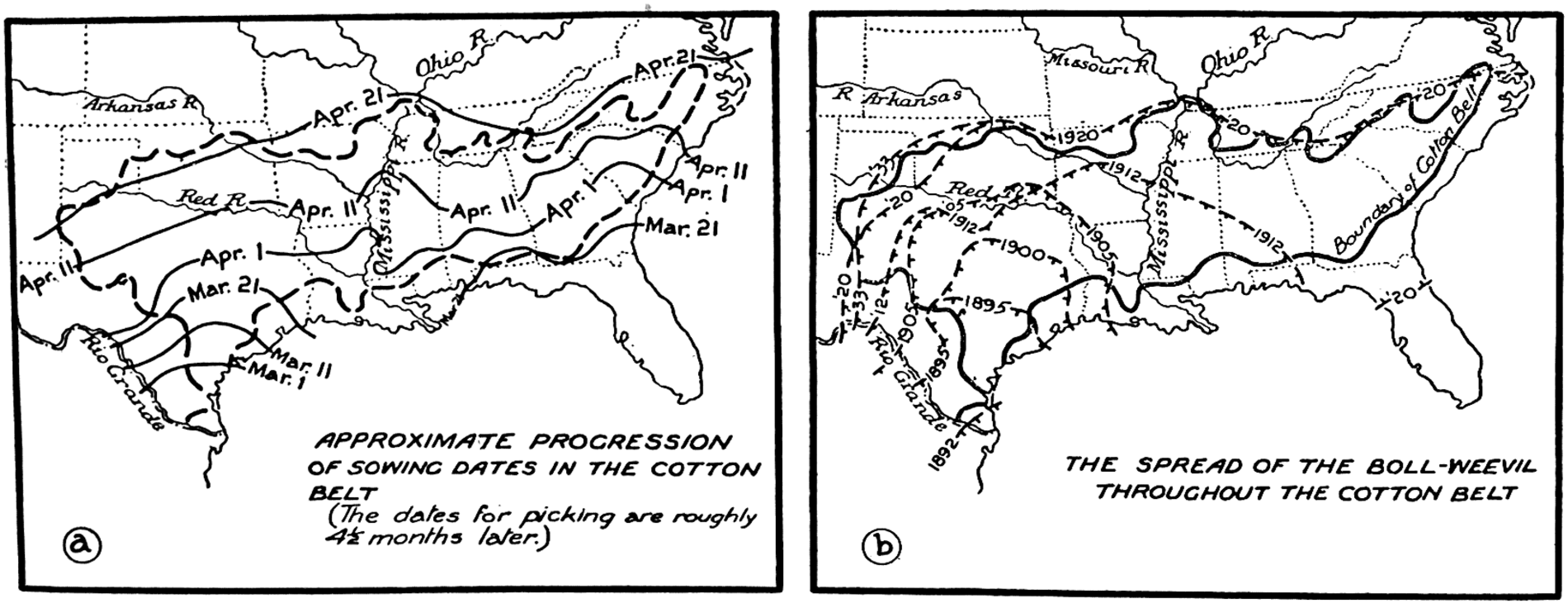

FIG. 119. Sowing dates and spread of boll weevil throughout the United States (*After Department of Agriculture, U.S.A.*).

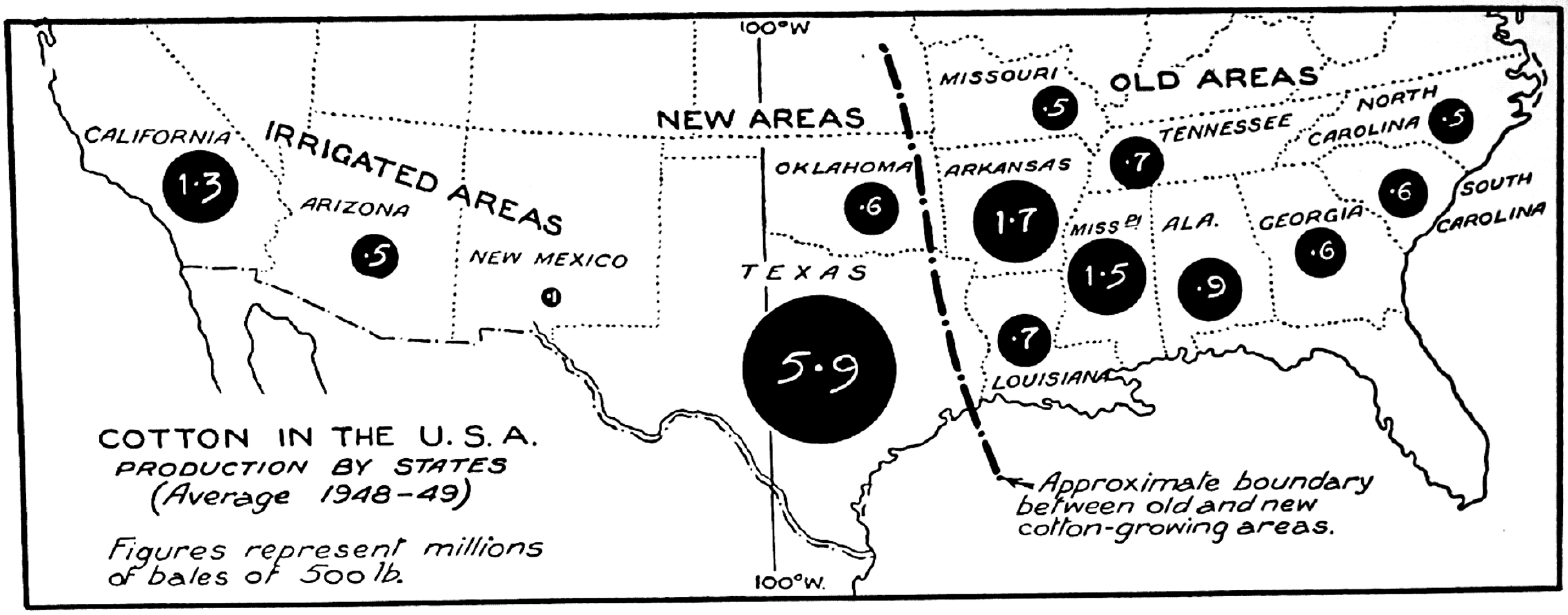

FIG. 120. Cotton production (by States) in the United States.

crop system. This meant intensive hand labour under very poor living conditions. Of late years the situation has improved with the advice and assistance of government agricultural experts. Production from the nine States included in the area is approximately 45 per cent of the total for the United States. On the other hand the yields per acre are low and the total production and yields are both declining, e.g., between the years 1937 and 1949 the number of bales produced in these nine States dropped from 11,645,000 to 7,400,000. In the States of Alabama, Georgia, Mississippi, North Carolina and South Carolina, the production of 1949 was only half what it was in 1937. Authorities attribute this falling-off to soil exhaustion brought about by the sole cropping of cotton over many years and the failure to practice crop diversification. The measures introduced to meet this alarming situation, especially with its implications for future employment and living standards are dealt with in Figure 121. It is worth noting that the Carolinas and Georgia are the major centres of the textile industry with fall-line power and strategic transport available.

2. **The new area.** Texas is the principal State here, and together with Oklahoma produces about 35 per cent of the cotton of the United States. Reasons are to be found in the famous black waxy soils, the larger farms, and the mechanization at all stages of cultivation. Machines are used for planting, thinning, weeding and harvesting. Of special interest is the use of aircraft in the dusting of fields for pest control. But these measures have not excluded hand labour entirely and there is still a tenant class (Figure 122). Production to-day is slightly higher than that of the pre-war period, but the yield per acre is estimated to be 50 per cent greater than for those earlier years. Although Texas has been exploited for cotton for many years, it is thought that it could produce many other valuable crops.

3. **The irrigated areas.** These include lands in California, Arizona and New Mexico. In these regions cotton field acreage has increased by 50 per cent since 1939, the production has been stepped up by 100 per cent, and the yield per acre advanced by 25 per cent. Important factors in these rises are the extension of irrigated land, long hours of sunshine, ability to apply water when needed, increasing mechanization of all stages of the growing and harvesting and specialization in the long staple Egyptian cotton which is in great demand for the manufacture of motor tyres, dress materials and shirtings. A major cost, however, is that of haulage from the inland regions, e.g. Salt River.

Significant developments. Since 1920 there has been a 50 per cent decrease in the acreage of cotton in the United States, but an increase in output of some 10 per cent. This has been brought about by:

(*a*) the opening up of new lands in the western States;

(*b*) the introduction and utilization of better cotton types;

(*c*) a more scientific approach to farming in the newer areas;

(*d*) an increase in the mechanization of cotton-growing in all its phases;

(*e*) the development of irrigated cotton crops with increased yield, e.g., the yield per acre from an irrigated area is roughly two and a half times that of the old cotton farmlands.

Major groupings of associated crops (Figure 121). As pointed out in comments on Figure 119 the advent and ravages of the boll weevil were important factors

in turning many one-crop farmers of the cotton belt to the cultivation of other crops. But further significant factors were:

(*a*) the depletion of soil fertility by the continued growing of the cotton plant in the same areas;

(*b*) the acceleration of active soil erosion by faulty farming practices;

(*c*) the fall of oversea markets in the thirties.

The solutions to such problems were the implementation of measures to provide heavy fertilization, prevent erosion and obtain government support of cotton prices. From the point of view of economic and human geography an important remedy was the adoption of more diversified farming wherein cotton was no longer the most significant crop but one of a series rotated according to scientific principles. This meant active education of the farmer so that he would

2. Winter wheat. Winter wheat appears in the drier north-western parts of Texas, where it has become an important part of commercial grain farming in that State.

3. Oats. These are produced as part of the rotation of corn and have proved useful as a feed for horses, pigs and dairy cattle.

4. Cowpeas. These are grown largely on the inner coastal plain and across portion of the lower Mississippi and are utilized as stockfeed and legume fertilizer.

5. Peanuts. These form a staple legume of the cotton belt agriculture and are grown widely as a green manure to restore and maintain the fertility of impoverished soils. They also form stock feed and are employed in the making of oils which are a substitute for butter and olive oil, (e.g., peanut butter). The plant has many chemical uses in industry as well

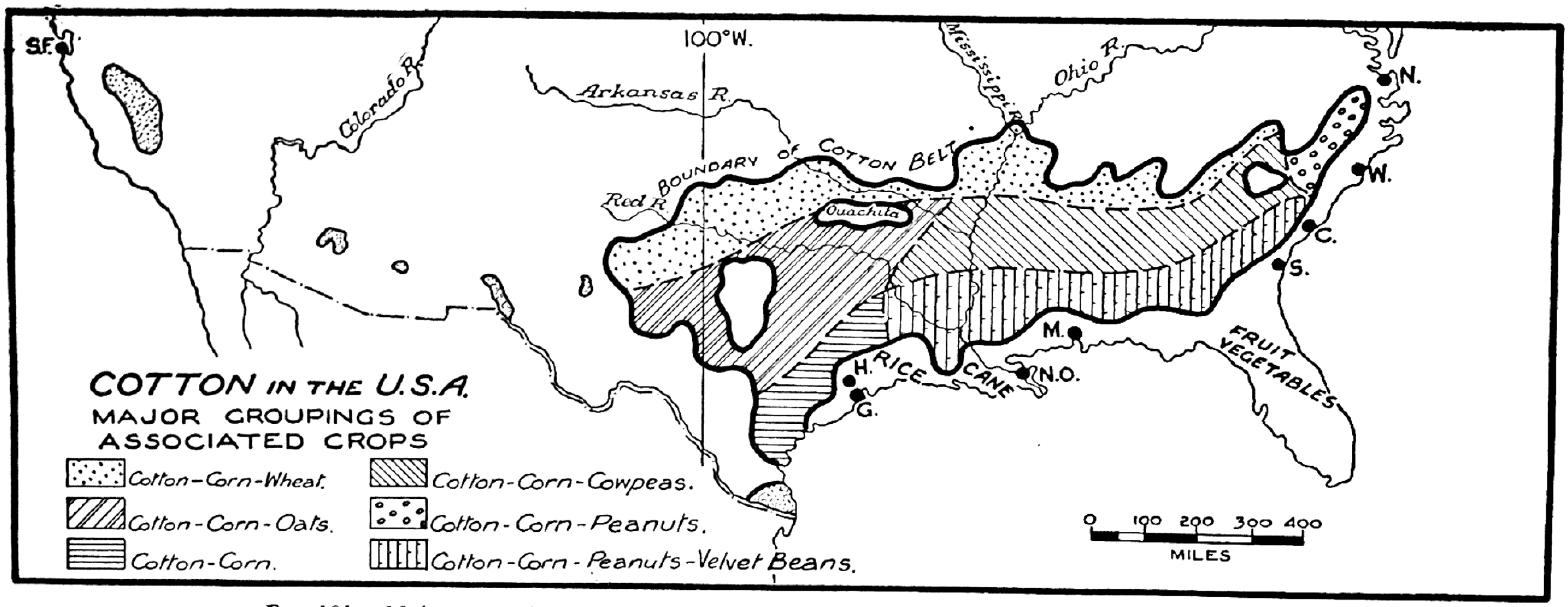

FIG. 121. Major groupings of associated crops in the cotton belt of the United States.

divert some of his cotton acres to such produce as peanuts, fodder for sale in the animal-raising lands to the north, and fruit, vegetables, chickens, pigs and dairy cattle. Farmers who adopted these measures can now obtain a living no matter which way the cotton market goes. At the same time there are protective covers for the soil and a means of building up and maintaining its fertility.

For the above reasons Figure 121 is of special interest. It shows the major groupings of those crops which have come to be associated with present-day growing of cotton. General information on these includes the following:

1. Corn. This is grown everywhere for human consumption and in the wetter areas of the south as a livestock food and has much the same acreage as cotton. Because of the cost of production it does not figure as a money crop.

and its amazing versatility is a tribute to the great negro chemist, Washington Carver.

6. Velvet beans. Velvet beans act as fertilizers and provide hay feed (especially for pigs) which can be utilized after the harvesting of the wheat and oat crops. The actual plant foliage acts as a cover to prevent soil erosion.

Livestock are playing a greater and increasing part in the cotton belt. A factor favourable to this development is that animals may be pastured almost all the year if proper rotation is followed and ensilage stored. For example on the "black prairies" of Texas, pasture lands on what were formerly badly eroded cotton fields are now supporting considerable numbers of beef cattle, especially since the tick pest has been brought under control.

Dairy farming is becoming increasingly successful in

producing supplies for the expanding industrial cities in the south. Numbers are also maintained for purely domestic purposes. With regard to cattle as a whole in the cotton belt, the long growing season there encourages a wide range of crops, but cold waves (some freezing) limit winter crops to hardy forage and winter grains and so point the way to a bigger animal industry.

A mixed farming economy has brought to the cotton belt an increasing mechanization of agriculture, factories for processing crops and a wider use of fertilizers. This has resulted in a demand for more labour all the year round, seasonal activities, and a growing urbanization. For the latter effect reference can be made to Figure 59 to see the relative density of population within this particular area, as well as to study its relationship to other regions of the United States. Figure 95 will also supply interesting comparative material.

In the coastal regions marginal to the cotton belt, climatic and soil conditions forbid the growth of cotton, but allow an intensive commercial cultivation of sugar-cane, rice, fruit and vegetables. Much of this produce moves to northern markets.

Farm economy in the cotton belt. General. The typical cotton farm in the old plantation regions, where large estates were subdivided, is nowadays about 40 acres in extent. Of this, about half is in cotton, about 10 acres in maize, and the balance in fodder crops and vegetables. Many such properties are worked under a share-cropper system whereby the tenant provides the labour and possibly some fertilizer, while the owner is responsible for the rest of the farm equipment including a house and fuel. The principal alternate crops here are maize, with the addition of winter wheat on the northern edge, and peanuts, velvet beans and cowpeas on the south-east (Figure 121). One or two work animals are kept, and a few pigs and cows. Dairy cattle supply the farmers with fresh milk. In parts of the deep south where soils are less favourable, small farms of about 15 acres are sometimes operated by poor white owners with the assistance of a single mule. By contrast with the above, the newer cotton lands in Texas and Oklahoma have developed larger farms of up to 300 acres in extent. Here the principal alternate crop is grain sorghum and tractors are often used in place of the work animals of the old region (Figure 95).

Farm routine. To grow his cotton as well as produce the associated crops at various seasons of the year, the farmer of the belt is kept working continuously throughout the year. The following is a general outline of the routine normally carried out:

1. For cotton, the land is ploughed in late autumn and early winter so as to take advantage of soil moisture for the planting. In this preparation the old plants are destroyed or ploughed in so as to kill pests, including the boll weevil, which may remain dormant in the winter.

2. The seeds are planted at various periods beginning in March and ending in April (see Figure 119). The work is done with drills drawn by mule teams (or tractors in Texas) or by hand. Much seed is put down so as to get a heavy growth.

3. When the plants are well established they are thinned out up to two feet apart so as to permit the later spread of foliage, maximum heat, and a more effective pest control.

4. The onset of summer temperatures and rains means two new tasks for the farmer: repeated cultivation for weeds and precautions against the boll weevil. This entails destroying insects and bolls damaged by them, as well as dusting with arsenate of sodium poison. Most of these processes are now mechanized.

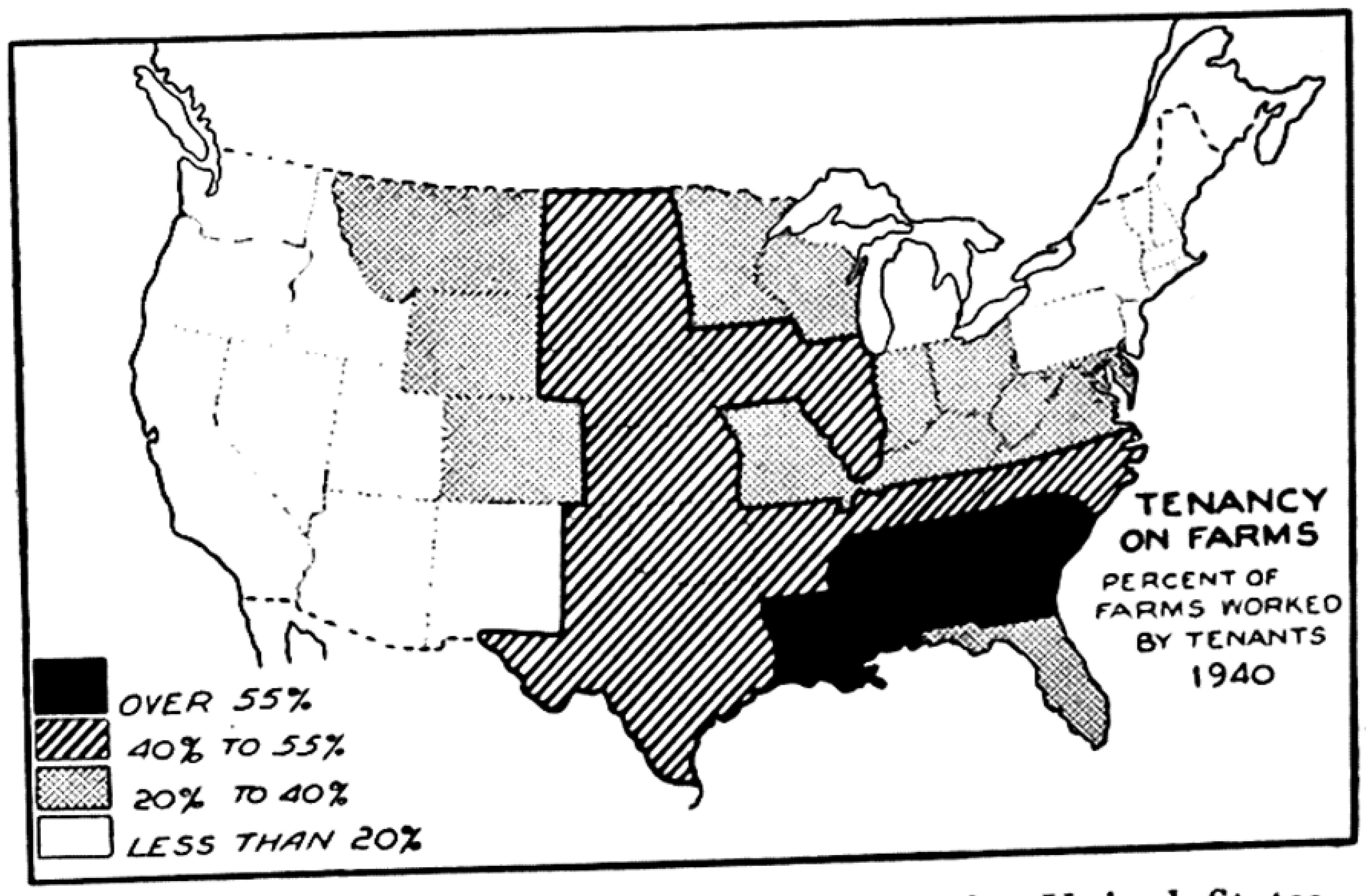

Fig. 122. Tenancy on farms throughout the United States, 1940.

5. Finally comes the picking, which generally begins in the south about July and in the north in September. It is a long process in the older areas and may continue for two or three months, since each boll must be gathered separately. It is necessary for pickers to go over the field several times, since the bolls do not ripen uniformly; the lower ones mature first and the rest at intervals until the last are often killed by early frosts. It is usually done by hand. In California and Texas, large fields with uniformly ripening cotton types allow mechanical pickers to operate.

In the same periods, prior to, between and after its cultivation and picking, the farmer's time is taken up with tending other crops. But he cannot give much time to these since in the long run cotton represents the major cash return from his property.

Tenancy on Farms (Figure 122). Only a relatively small percentage of farms in the United States is actually occupied by the owner. There are obviously variations throughout the country and these will be examined below, especially the position in relation to the cotton belt. It is held by some authorities that tenancy is

showing an alarming increase. Such changes in ownership status have a special geographical significance. For example, it has been found that tenancy generally increases destructive exploitation in farming. In other words, farmers who do not own their own properties are rarely interested in either maintaining or increasing the soil fertility of the fields they work, and so it is true to say that there is a marked correlation between tenancy, bad farming practice and erosion.

1. This is particularly the case in the older parts of the cotton belt, for it is here that the poverty-stricken share croppers are found in their greatest numbers. Their forebears were Negroes who gained their freedom following the Civil War and poor whites who moved in after many coloured people migrated north in the twenties. The crippling system of which they are part had its origin in the breaking up of the large estates whereby certain economic conditions arose and proved favourable to those forms of tenancy in which rent, implements, supplies and ready cash were advanced on the crop as security. Money in particular can be borrowed at ruinous rates of interest because of the lasting qualities of cotton itself. To-day many of the tenant farmers are habitually in debt, and few of them have either the means or the inclination to improve their farms and living conditions or to maintain soil fertility by manuring heavily. This means falling crop output and eventual abandonment of farms and consequent soil erosion. Mention has been made elsewhere of government measures to offset this depreciation in land and people, since many of them are both undernourished and subject to disease. Possible rehabilitation may also be found in the mechanization of farming and in the great progress in manufacturing which has occurred in the cotton belt in recent years, so that less than half its population is now to be found in agriculture. Improved supplies of electricity, new pools of labour, new inventions and technological processes, increased use of raw materials for industry, and better transport and marketing of cotton and associated crops have all contributed to industrialization across the belt from North Carolina to Texas. New settlements are coming into being and old ones being enlarged to meet the demands and growing population concerned with the refining and processing of oils (cotton-seed and petroleum), milling of flour, packing of meat, making of fertilizers, textiles and clothes, and the work of the timber mills—to mention but a few industries. Perhaps this change will mean a successful way out for the poor farmers of impoverished soils, as did the peach industry in Georgia years ago, when the boll weevil eliminated the cotton growers.

2. In looking at other percentages of tenancy in the United States it is worth noting the changes and circumstances in the corn, wheat, and newer cotton lands. Here many farm owners have been reduced to

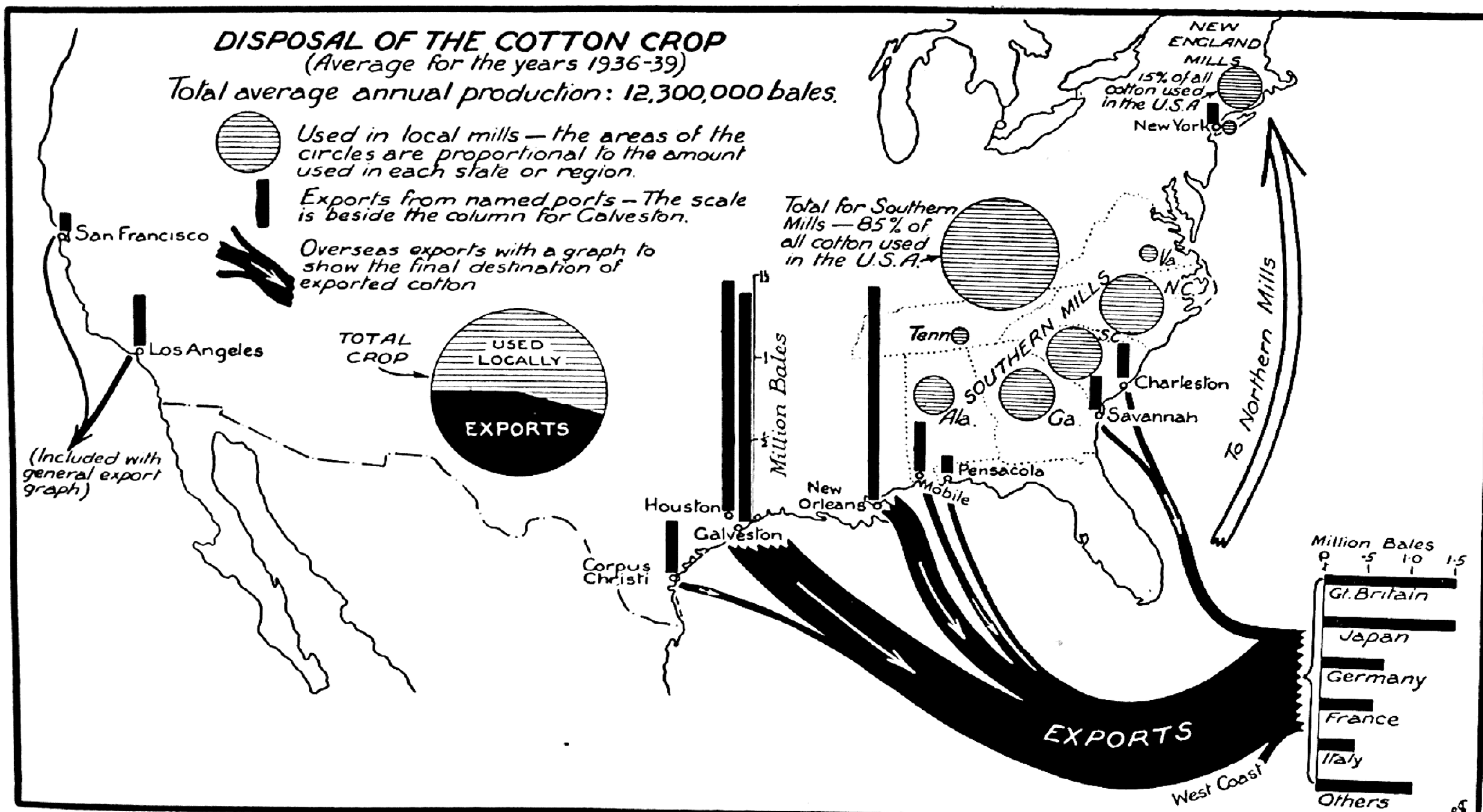

Fig. 123. Diagrammatic summary of the disposal of the American cotton crop.

tenant status in the past. This is because declining prices from time to time have reduced the value of their farms to less than the face value of mortgage obligations which they contracted in boom years. Here again, growing farm mechanization (the bulk of the United States's $3\frac{1}{2}$ million tractors are here, Figure 95) and the demands of new industrial centres may change the position.

3. The lower percentage of tenancy in the vegetable, fruit and dairy farming of the eastern States, including Florida, is due, in part, to the large and constant demands for their produce by urban centres. In addition, many farms are small, intensively cultivated, and worked by small families without much hired labour. Exceptions are the produce concerns run on a large scale by corporations and co-operatives, e.g., California and south-east Texas. Many groups are old established farming communities with a solid background of thrifty European peasantry.

4. The percentage is lowest in the marginal lands of the west. Here the extensive nature of the pastoral activities which dominate the rural scene calls for much capital investment and absentee ownership by large companies.

Disposal of the cotton crop (Figure 123). In studying this map, note the special significance of the symbols in the key. From them valuable comparative findings can be made on local consumption, ports of export and oversea movements.

1. Local consumption. (*a*) The map shows the latest available figures for all aspects shown on it. The figures are for years 1936-39, but in the discussion following, later data will be given where available.

(*b*) Of the total annual production of 12 million bales, 55 per cent is used locally and the rest exported. In 1949, of a 16 million bale production, 68 per cent was taken up in the States and the rest went overseas.

(*c*) In the case of the cotton absorbed within the country, some 85 per cent was taken up by the mills in the piedmont industrial belt and 15 per cent by the textile firms of New England. This disparity can be attributed to the southern manufacturers' concentration on the production of cheaper and coarser materials, while those of the north excel in the fine cottons and fashion clothing.

2. Export of the crop. (*a*) The three principal ports are Houston, Galveston and New Orleans, with Los Angeles becoming increasingly important.

(*b*) Prior to World War II, the principal countries taking United States cotton were Great Britain, Japan, Germany, France and Italy. In 1949 oversea exports went to a wider field of foreign buyers, United Kingdom (half its 1939 purchases), France, Japan, Italy, Germany, Canada, China, the Netherlands, Belgium and Spain.

ORCHARDING IN EASTERN AUSTRALIA

A proper appreciation of both types and acreages of fruits produced in the various regions of New South Wales can best be gained by a joint examination of Figures 124 and 125. Special care should be taken to make proper reference to the keys of both sketches.

1. Many different kinds of fruit are grown because of the varying conditions of topography, aspect, soils, climate, transport and markets. Landforms most suited to this kind of specialized farming are foothills and slopes where there is protection from wind and where drainage is good. Soil requirements naturally vary according to the type of fruit, but in general, deep friable loams are the best. Almost all fruits need a wet climate. In dry climates, which are actually beneficial for pest and disease control and fruit quality, they must be irrigated.

2. Contrasts are offered between certain areas shown in:

(*a*) the total, or almost total, specialization in such parts as the north coast valleys, the tablelands and slopes; and

(*b*) the variety of the central coast districts and the irrigation areas.

3. Especially significant are the comparatively new sections of the west and south, where irrigation has transformed what were previously only pastoral

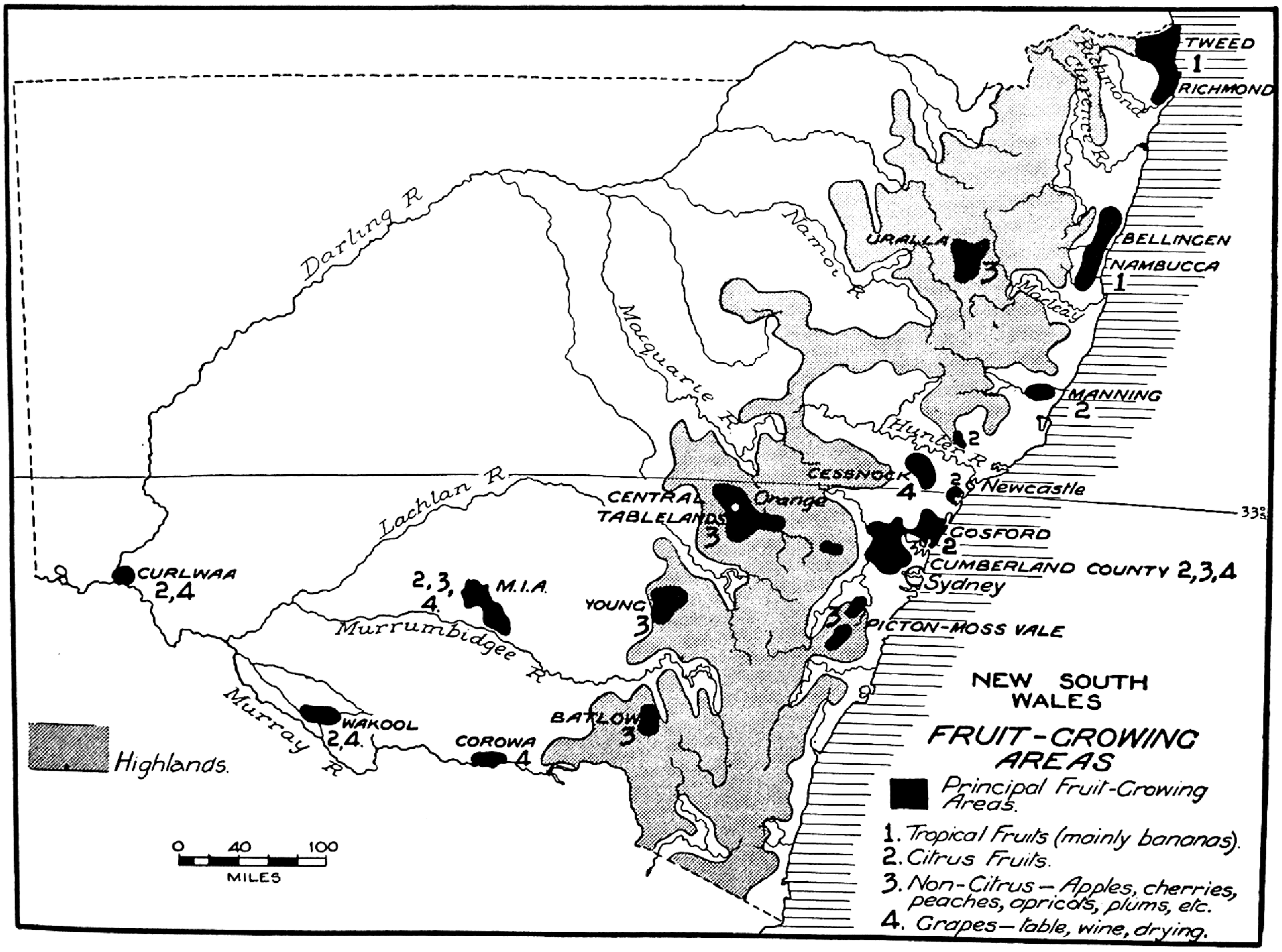

FIG. 124. Fruit-growing areas of New South Wales.

holdings, e.g., the Murrumbidgee Irrigation Area and Curlwaa.

4. Certain general features can be said to be common to all the types of orcharding mapped here.

(*a*) Farms are small, being from 10 to 50 acres, but needing constant care, e.g., bananas, oranges or peaches. Where a property is not wholly suitable for fruit, vegetables may be grown in association, e.g., peas at Orange and peas and beans around Gosford.

(*b*) Mechanization may be small in some crops (e.g., bananas) in which cropping and routine work (such as weeding, spraying and harvesting) is carried out manually by the farmer and family; but in other orcharding areas mechanization is considerable. Farm buildings are usually few, small and located very close to or in the orchards.

(*c*) The type of fruit grown may have special dependence upon transport and market factors, e.g., contrast the variety in the immediate Sydney hinterland and the specialization of centres like Batlow.

(*d*) In the disposal of the crop the bulk of the fresh fruit passes through the Sydney and Newcastle fruit markets, where it is handled by wholesale agents or by State Marketing Boards. The irrigation areas produce much dried and canned fruit as well as fresh fruit, e.g., the Murrumbidgee district cans much of its crop while the more distant Curlwaa dries fruit in a hot, semi-desert climate. Large amounts are preserved as jam or used for the production of wines and fruit juices. The canning industry has shown considerable expansion since World War II: markets (other than local) are principally in England, Canada and New Zealand. The industry is hampered by a shortage of tin plate, but the new tin plate mill at Port Kembla will relieve this. In most orcharding areas there are central packing sheds where the fruit is washed, graded and packed; and in some areas there are cold stores for holding the produce locally. These are often in the town centre for the district.

(*e*) Orcharding in New South Wales has been advanced by irrigation along the Murrumbidgee and Murray and by the application of the various processes mentioned above. There is further room for expansion depending in some measure upon research, since losses are considerable from pests, weather changes, packing, storage and transport.

Two features of orcharding which are well worth noting here in relation to other forms and locations of agriculture are:

1. The pattern of land occupancy is in marked contrast with, for example, wheat-growing, displaying as it does a systematic and orderly lay-out of trees, fences and buildings.

2. Important fruit-growing areas occur also in other States, more especially Queensland and Victoria. These are the subject of Figures 126 and 127.

For details of the different fruits shown, these aspects are worth noting.

1. **Tropical fruits.** Bananas are the main crop and require special conditions of well-drained slopes with a northerly aspect, rich soils and hot, wet summers. As a result they are strictly localized along the north coast from Nambucca to the Tweed districts. Actually the total production of bananas exceeds that of any other single fruit in the State, the Tweed-Richmond area producing 73 per cent and the Dorrigo-Nambucca 25 per cent. Associated fruits of lesser production are pineapples, papaws and passion fruit.

2. **Citrus fruits.** The maps indicate well-defined areas for citrus growing.

(*a*) The coastal areas about Gosford, in the Cumberland county and the Manning and Hunter valleys.

(*b*) The western irrigation areas along the Murrumbidgee and Murray rivers.

This spread can be accounted for by economic factors and by the occurrence of suitable climates and of sandy soils which are well drained. The large acreage of the metropolitan area can be explained also by proximity to markets and processing factories and by good communications. Peas and beans are often grown in conjunction with the oranges and lemons. From the point of view of production, the quantity of oranges grown is twice that of any other fruit except bananas, with the Gosford-Sydney district yielding 55 per cent and the Murrumbidgee Irrigation Area 40 per cent. Fruit production in bushels in 1948-49 was: bananas 2,400,000; oranges 2,060,000; apples 1,054,000; peaches 710,000; lemons 373,000 and pears 355,000.

3. **Deciduous fruits.** There are many varieties within such a classification and they are spread over much of the State. But there are some strong localizations shown on the map.

(*a*) Apples, pears and cherries show a strong preference for the tablelands and slopes with Uralla in the north, Orange in the centre and Batlow in the south being especially important, where cold frosty climatic conditions and heavier soils occur.

(*b*) Peaches, pears and plums have proved good table and processing fruits in the irrigation centres already indicated.

Significant production figures for deciduous fruits are:

(*a*) Apples: Central Tablelands, 36 per cent; Northern Tablelands, 17 per cent; Batlow-Tumut, 16 per cent; Southern Tablelands, 15 per cent; Murrumbidgee Irrigation Area, 15 per cent.

(*b*) Peaches: Murrumbidgee Irrigation Area, 56

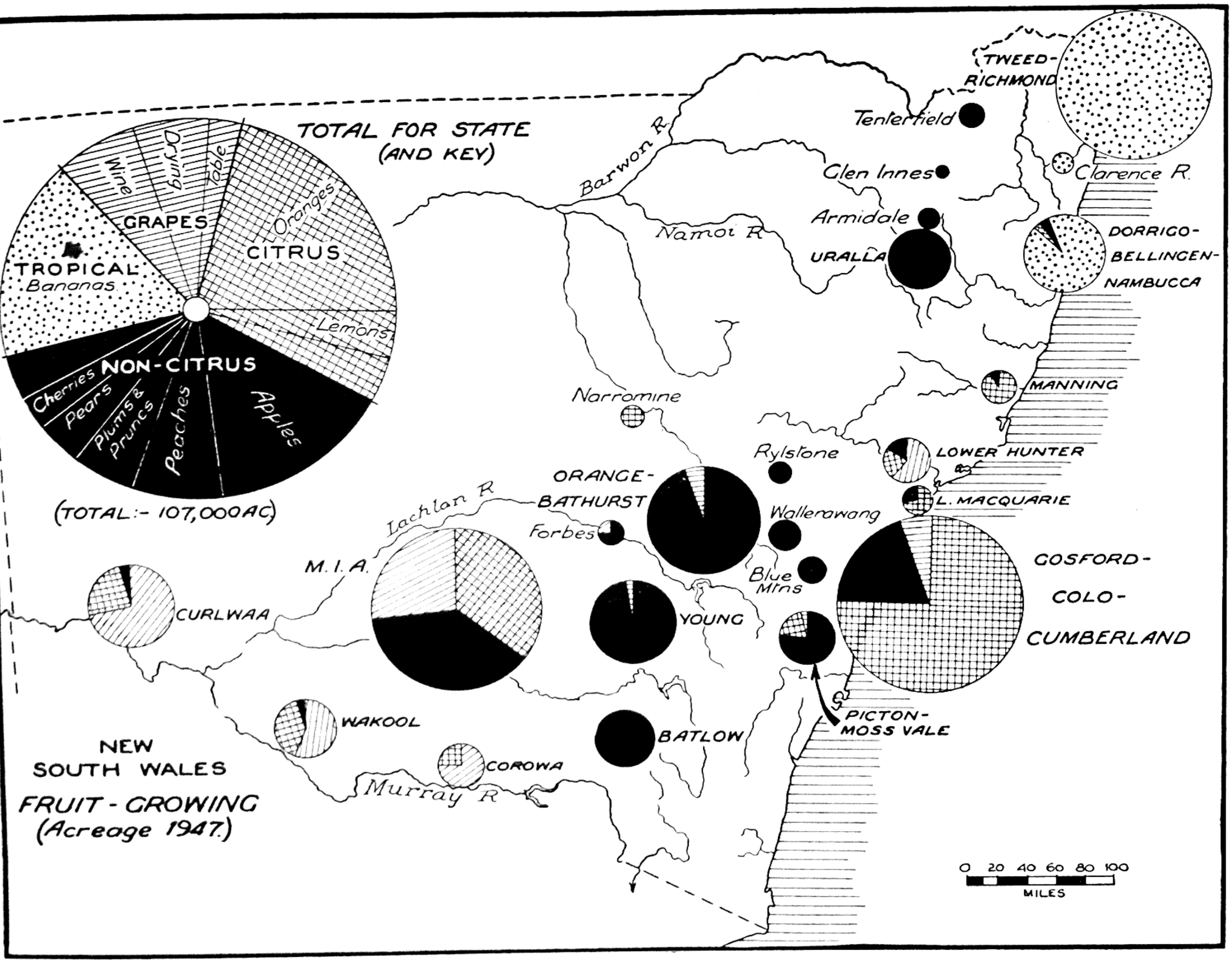

Fig. 125. Fruit-growing acreage by districts in New South Wales

per cent; Sydney-Gosford, 25 per cent; Central Tablelands, nine per cent.

(*c*) Pears: Central Tablelands, 35 per cent; Murrumbidgee Irrigation Area, 20 per cent; Tumut, 22 per cent.

4. Grapes. Grapes serve several purposes which are met by the crops from all the major districts of the lower Hunter and the several irrigated sections of the State. Specialization in wine types is noticeable in the lower Hunter and Murrumbidgee Irrigation Area, while such centres as Curlwaa are adapted to the production of dried products (sultanas, lexias, and currants).

Queensland fruit-growing (Figure 126). The fruit-growing industry of Queensland differs markedly from that of the other eastern States because a large proportion of it is made up of tropical varieties. It is practically the whole Australian source of many such fruits (see Figures 124, 125, 126 and 127).

1. Production, on the whole, is highest in the south-eastern districts of the State and decreases to the north.

2. A greater variety of fruits occur in the south and includes the major portion of those other than tropical, e.g., pome, stone, grape and citrus. The first three mentioned are confined almost entirely to the Darling Downs district.

3. Apart from the Downs, West Maryborough and Atherton areas, cultivation is restricted exclusively to the coastlands, and even here it is sporadic in location north of Maryborough.

4. There is no fruit-growing on a large scale by irrigation methods.

1. Bananas. Queensland supplies approximately one-fifth of the Australian banana crop as against four-

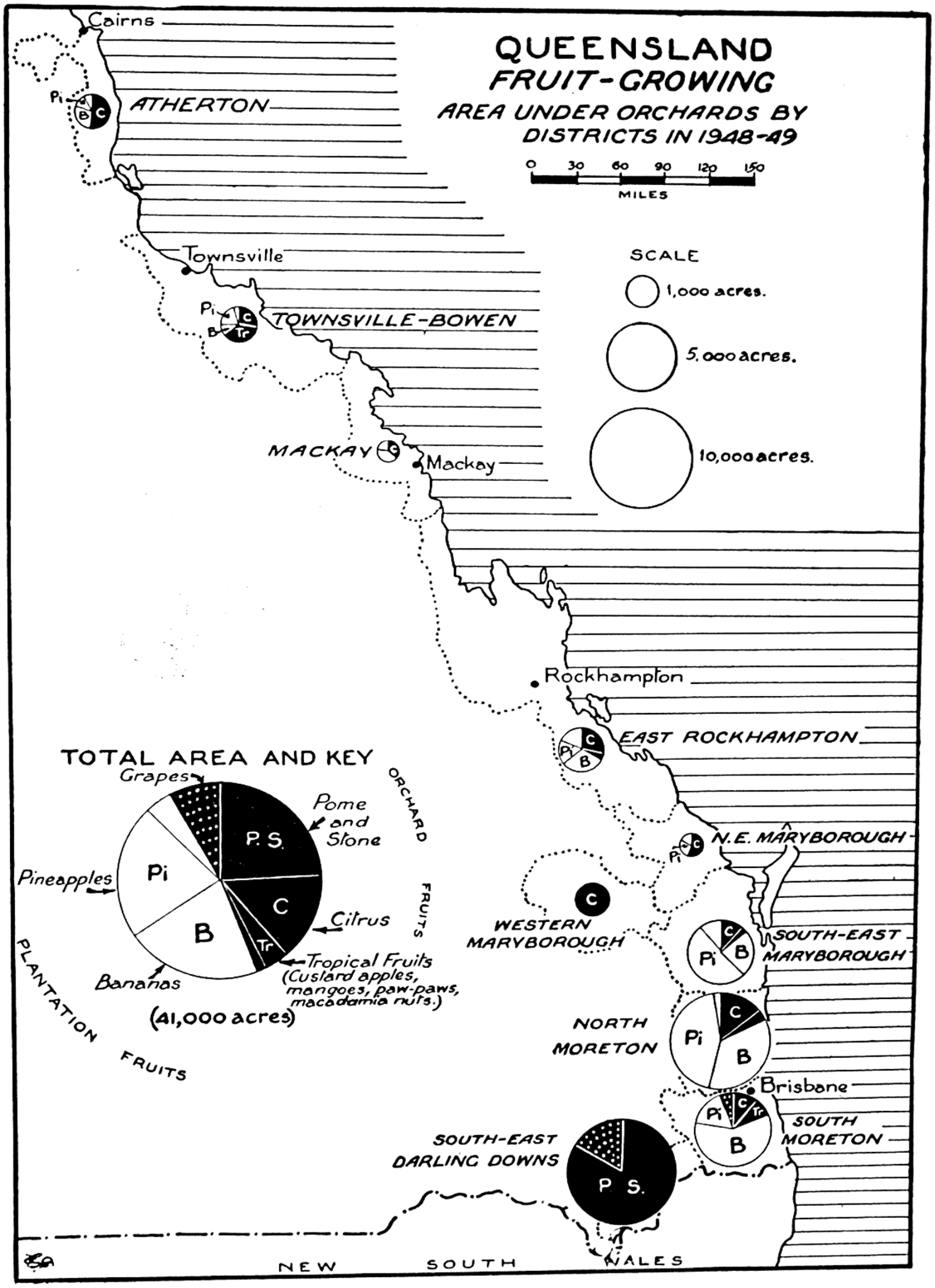

FIG. 126. Fruit-growing areas of Queensland.

fifths from New South Wales. It comes chiefly from the Maryborough and two Moreton districts, where there are suitable conditions of loam soils on steep hillsides with good drainage and aspect and a rainfall not as high as in the northern areas. It is important to remember that soil erosion is a serious menace, unless countered by contour planting and terracing. Although other coastal parts grow bananas little suitable land is now available and the industry faces competition in southern markets from New South Wales. In order to reach those markets in good condition, recent years have seen improvements in ripening methods and speedy transport. Experiments have also placed canned bananas on the market.

2. **Pineapples.** These are grown mainly in the same districts as bananas and need frost-free land and very good drainage no matter what the type of soil available, although that of a friable acid nature seems the most suitable. Erosion is also a problem on these plantations. Production is increasing and the surplus is canned and crystallized both for Australian and

oversea markets. Queensland supplies 98 per cent of the Australian production and the value of the crop is twice that of bananas from that State.

3. Other tropical fruits. These flourish throughout the coastal sections of the State. But with the papaw and custard apple there is a particular concentration about the rural-urban fringe of Brisbane in order to supply the markets there and to be near the main transport lines south since they are perishable fruit. Canned and crystallized papaw are now available to the Australian public.

4. Pome, stone fruits and grapes. Apples, pears, plums, peaches and apricots are suited by the cool climatic conditions and soils of the upland country around Stanthorpe. Grapes for wine and table occur here too and in the South Moreton district. They are mostly grown to supply the local market.

5. Citrus. These appear throughout the coast to Townsville as well as on the Atherton Tableland and meet local demands. It will be noted that North and West Maryborough are exclusively citrus areas. Oranges and mandarins are the most popular types.

Victorian fruit-growing (Figure 127). Victoria is concerned mainly with the production of vine, pome and stone fruits. The first two varieties actually represent well over half of the State's fruit. The whole key itself forms an interesting contrast with that drawn for the northern parts of the country e.g., Queensland.

1. The eastern and western districts have a relatively low output of fruits with some counties showing no commercial production at all.

2. The central districts near the metropolitan area of Melbourne are interested in pome varieties but show a fair proportion of stone fruit orchards. The over-all acreage here is much greater than the east and west, and is closely related to the demands of urban markets.

3. In the northern, north-eastern and north-western counties there is much land given over to vine, stone and pear orchards. Irrigation is largely responsible for

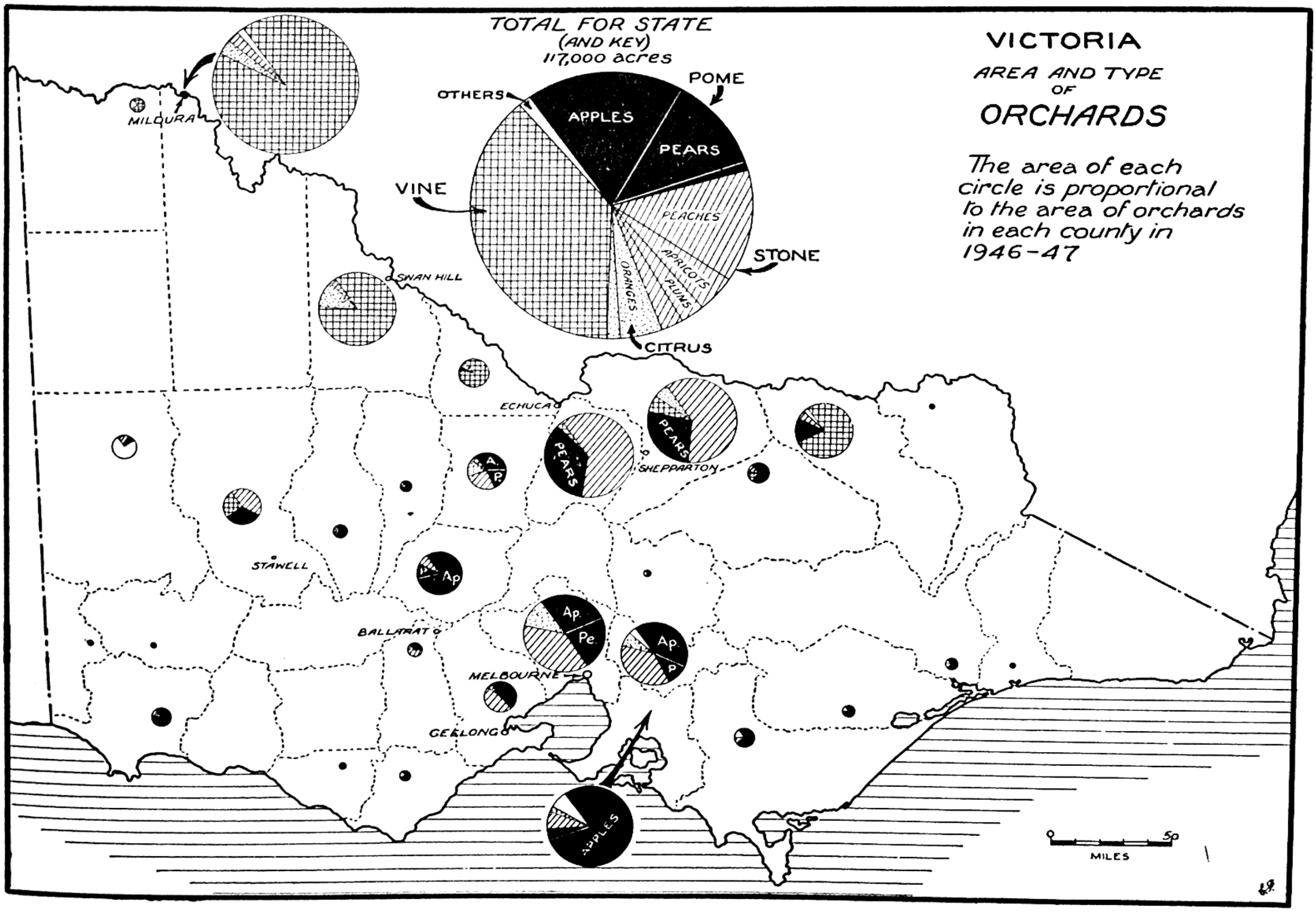

Fig. 127. Fruit-growing areas of Victoria.

certain localizations of these in the Murray Valley and the lower Goulburn Valley.

1. **Vine fruits.** These include wine and table grapes, sultanas, lexias and currants. Over 80 per cent of the Victorian vineyards are about the irrigation areas of Mildura and Swan Hill. Outside such areas, Stawell and Rutherglen are the strictly wine grape centres. Those near Albury can be classed as rain-grown vines. Although wine-making is on the increase, a large proportion of the fruit from vines is dried. This is especially the case with the lower Murray, where a hot, dry period between November and March prevents rain damage to fruit and assists in its processing. Only occasionally, too, are severe frosts likely to occur.

2. **Apples, pears and stone fruits.** These are the most widespread types of fruit, with specialization in the south, particularly east and south of the capital, and in the irrigation scheme of the Goulburn Valley to the north. Here the pears (mainly) and peaches are important for canning, e.g., at Shepparton. Apart from considerable local consumption, apples and pears are exported overseas with success, following experiments in cold storage and packing to withstand the long transport involved.

3. **Citrus.** Citrus production has declined in Victoria. A growing demand for grape fruit in local and interstate markets has stimulated its cultivation in the Mildura irrigation area along with oranges. Most lemon orchards are situated in the southern districts.

4. **Other fruits.** Berry fruits from irrigation and southern districts are mainly preserved, being made into fruit pulp for sale overseas.

MARKET GARDENING IN NEW SOUTH WALES AND VICTORIA

New South Wales. The growing of vegetables is now an important agricultural activity. Prior to World War II this form of farming was practised mainly in the near-urban localities. Here the traditional market gardener employed intensive methods of fertilizing and irrigation on even poor land to produce large amounts of vegetables. Their bulky and perishable nature was offset by the short transport involved. Large-scale methods had to be used to supply the Pacific forces and so there was an expansion of this primary industry in suitable but more distant rural areas, some of which had not grown vegetables before. Mechanization was introduced and the problem of long transport was met by both canning and dehydrating the produce. Some methods have come to stay, while fast and regular movement throughout the State can make profitable to growers the production and delivery of the more popular out-of-season varieties, like peas, beans and tomatoes. These go largely to the places of highest consumption, that is, the large towns. Even in these centres (and more especially with the inland settlements) fresh vegetables tend to be scarce and expensive because of costs of production. Droughts and floods add to fluctuations in supplies and prices. On the other hand preserved vegetables do not have as great a local demand in the earlier stages of their production, although they are useful in off-season periods. The export of these and fresh produce is small. Any further development of vegetable-growing will be calculated to meet a

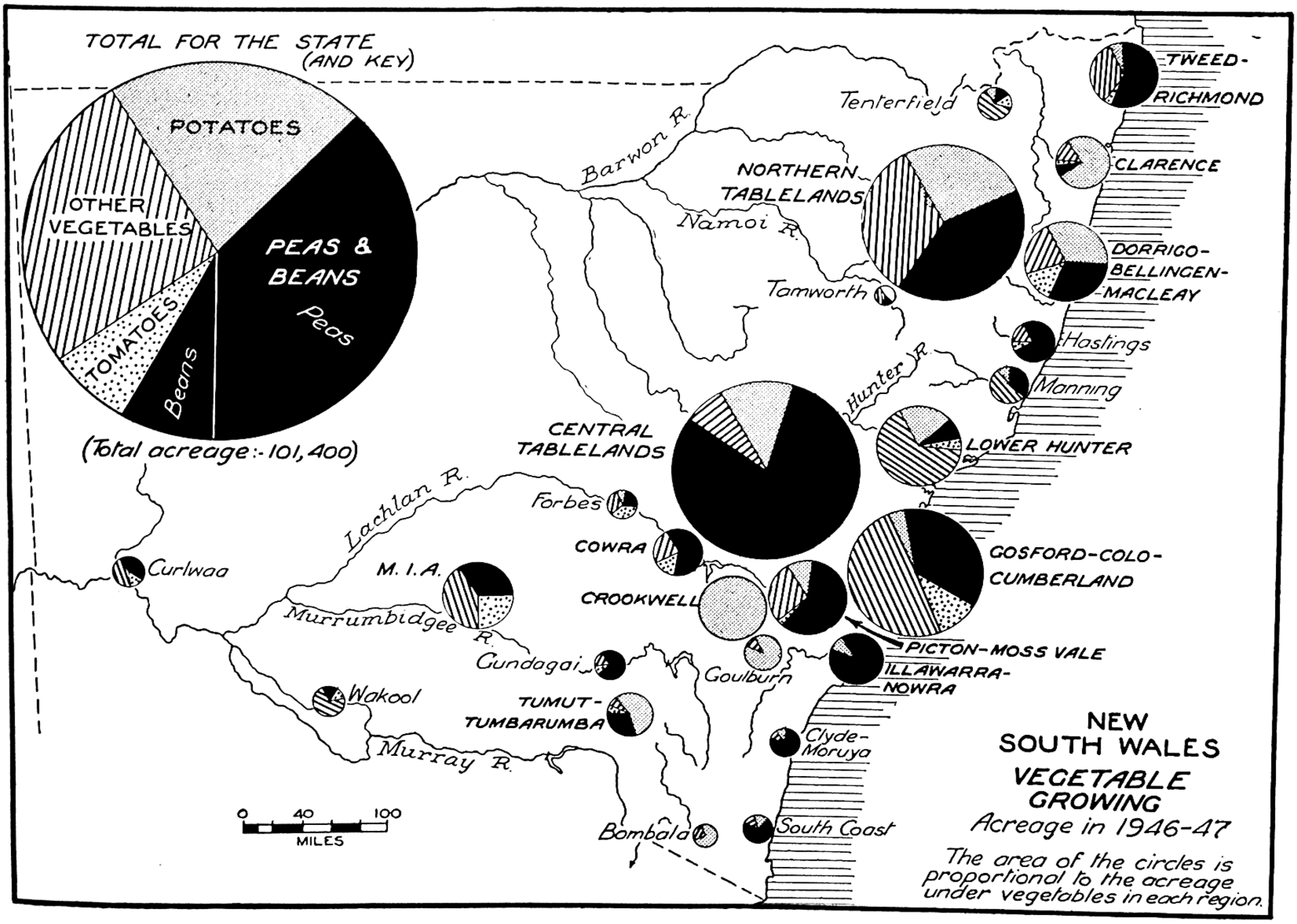

FIG. 128. Vegetable-growing areas in New South Wales.

possible expansion of both the human and farm animal population of the State and of Australia itself.

1. Production. Figure 128 shows that the main types of vegetables grown are peas, potatoes, beans and tomatoes. Pumpkins are important in the section shown as other vegetables. The total area under all of these in 1947-48 was 101,400 acres of which peas accounted for 36 per cent, potatoes 23 per cent, beans nine per cent, tomatoes four per cent, and other vegetables 20 per cent.

2. In those years the main areas of production were Central Tablelands, 22 per cent of the State total; Sydney hinterland (which includes Gosford-Wyong and Picton), 18 per cent; Northern Tablelands, 16 per cent; North Coast, 11 per cent; Southern Tablelands, 11 per cent; Hunter Valley, six per cent; South Coast, four per cent; Murrumbidgee Irrigation Area, three per cent; South-West Slopes, two and one-half per cent and Lower North Coast, two per cent.

3. There are three major production area groupings:

(*a*) The rural-urban fringe areas about Sydney and Newcastle.

(*b*) The more distant areas producing for local markets, the Sydney market and canneries.

(*c*) The areas associated with irrigation, mainly on a large scale, as in the Murrumbidgee Irrigation Area.

Within each of these groupings there are certain geographic and economic details which are worthy of closer study.

1. The rural-urban fringe. This has already been dealt with to some extent in *Regions and Men* (pp. 65 and 68), but further comment is worthwhile. Here the economic factor of markets determines the farming character. Since these areas are all close to the huge city consumer region they can afford high overhead costs for land improvement. Freight charges are low and the produce can be landed at the market in a fresh condition to command high prices. Within these near-urban localities are two main zones:

(*a*) An inner zone on the city fringe area where farms are small and practically the whole farm is under cultivation by intensive methods. Soils may be poor, but much manure is used and spray irrigation from the city water supply is common. Two or three crops may be produced each year by hand labour aided by simple machines, e.g., the rotary hoe. The actual type of crop grown depends more on the farmer's choice and the labour available than on climate or soil. There is a wide variety including such types as tomatoes (often in hothouses), lettuce, cabbages, cauliflowers, celery, carrots, parsnips, spinach, beet, beans, and peas, sweet corn and some potatoes. Most of these pass directly to the Sydney Fruit and Vegetable Markets by lorry, being delivered by night to meet the early morning buyers for the retail trade.

(*b*) An outer zone, along the Hawkesbury and Nepean rivers, and about Gosford and Picton—Moss Vale. Here the farms are larger, ranging from 40 acres to 300 acres, but only part of the farmland is under vegetable cultivation. The remainder of the property is devoted to dairying, poultry raising or growing fodder crops, and orcharding. This is a mixed farming area of which a clearer picture can be obtained by reference to Figure 129 of the Pitt Town-Wilberforce region and the accompanying text. Considerable quantities of vegetables from this outer zone pass to local canneries, e.g., Richmond and those in Sydney, as well as to the metropolitan markets for sale direct to the consumer.

2. More distant areas. Here the geographical circumstances of climate-soils-topography are the major factors in determining specialization of crop types and the farming pattern, e.g., contrast the diversity of production in the Dorrigo-Bellingen-Macleay area with the concentration on potatoes in the Crookwell district. These more distant parts are mainly on the rich river-flat land of the coast, and the stream valleys and patches of fertile upland soils located on the tablelands and slopes. The products are used either for sending to the Sydney markets, or for local canneries, which by their operation have led to increased cropping and the introduction of special varieties, e.g., asparagus at Bathurst and peas at Cowra. The outstanding rural region is the Central Tablelands, from which produce goes to the large Edgell cannery at Bathurst. Within the triangle framed by Bathurst, Oberon and Orange all types of vegetables are grown, but peas predominate. These are sown, cultivated and harvested by machines in paddocks of up to 40 acres in extent. When harvested the whole plant is gathered and taken by fast motor truck to the nearest pea-vinery where the plants are fed into a huge machine which separates the peas from the trash and passes them graded to size into boxes. They are then removed to the cannery and placed in tins for canning within four or five hours of being picked in the fields. The main canneries are situated at Bathurst, Cowra and Batlow.

3. Areas associated with irrigation. Most vegetable-growing areas practise irrigation of some form or other. Usually it is by water pumped from a nearby stream or from underground by windmills. But in the Murrumbidgee Irrigation Area and along the Murray irrigation by gravitation is employed. In these parts the over-all amounts of vegetables are small in comparison with most other districts of the State. This can be explained by the limitations of the market and by concentration on fruit-growing. Soil types determine in a large measure the varieties cultivated. Tomatoes, beans and green peas, for canning, are grown on dark heavy soils; carrots and melons, for Sydney, come from the sandier soils. Almost all crops are canned at Leeton.

Specialized farming on the Hawkesbury River, New South Wales. Figure 129 is an excellent example of land-use in specialized farming where the emphasis is on horticulture. The Wilberforce-Pitt Town area has a rural-urban fringe location in the county of Cumberland, New South Wales, and is concerned with the production of foodstuffs for the nearby metropolitan area of Sydney (see Figure 39 in *Regions and Men*). The generalized section (Figure 130) should be studied carefully in relation to the over-all pattern of land occupancy.

1. Much of the alluvial flat land of rich silts immediately adjacent to the river and below the 25-foot level is devoted to the intensive cultivation of vege-

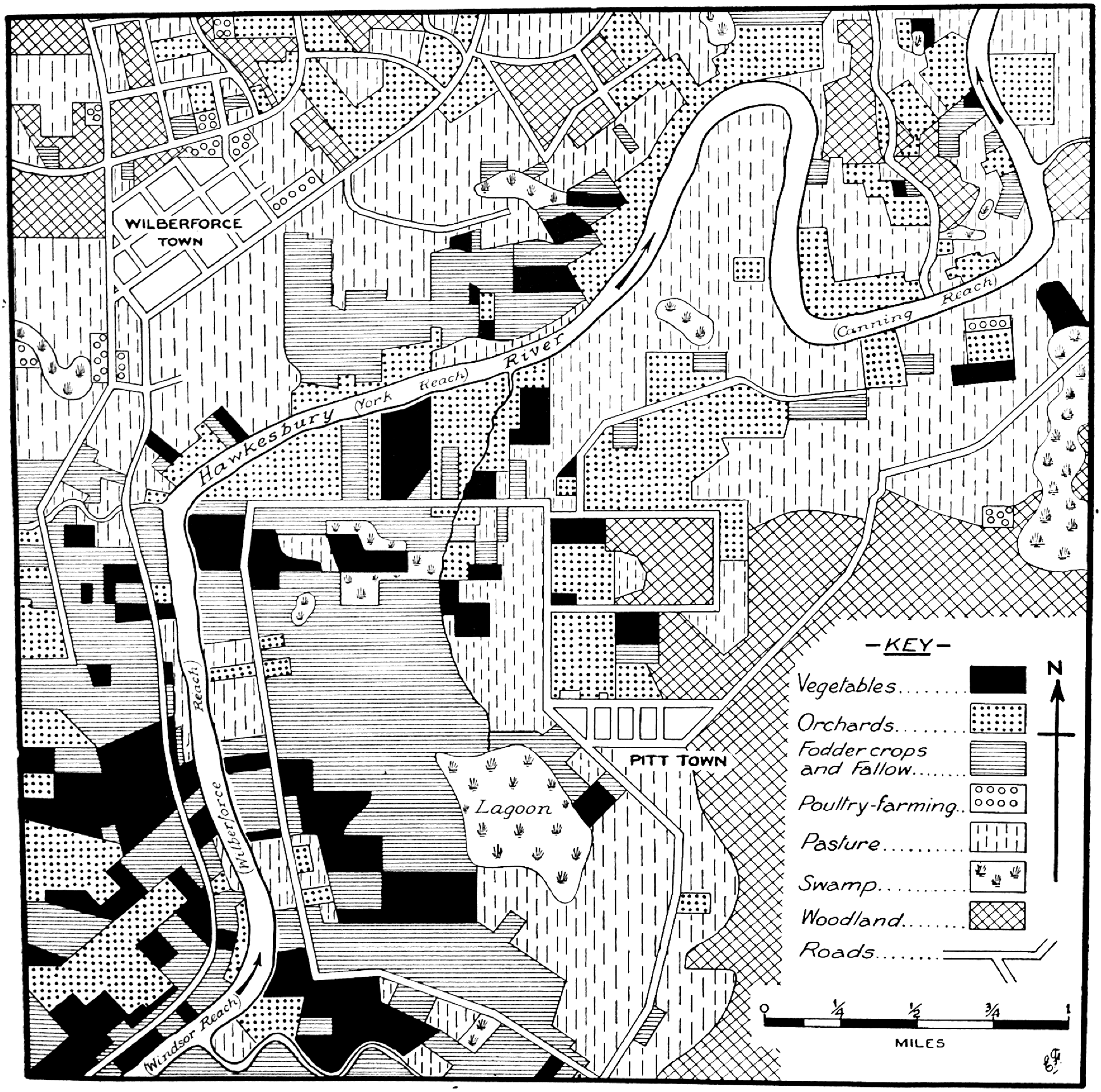

FIG. 129. Land utilization in the Pitt Town-Wilberforce area in the county of Cumberland, New South Wales (*After W. H. Maze*).

tables, the main types being root crops, cabbages, lettuce, pumpkins, cauliflowers and potatoes.

2. Associated with this culture on the flats are (*a*) dairying fodder crops such as lucerne and maize and swamp pastures about the lagoons;

(*b*) some orcharding of citrus on the suitable sandy loams of the levees, on which homesteads may be built.

Floods are a constant danger in these lower parts, but closeness to the river permits irrigation by pumping water directly from the streams and distributing it both by channel and overhead spray methods.

areas of alluvial land available and the water supply of the river, which may have marked seasonal variations in volume.

(*d*) There is generally no crop sequence, the crop most suited to the season of the year, markets and available labour being planted. Local processing of products is not practised as in centres much farther from urban populations demanding quantities of fresh foods daily, e.g., the Murrumbidgee Irrigation Area and central west of the State. However, there is some movement of vegetable crops to canneries in Sydney.

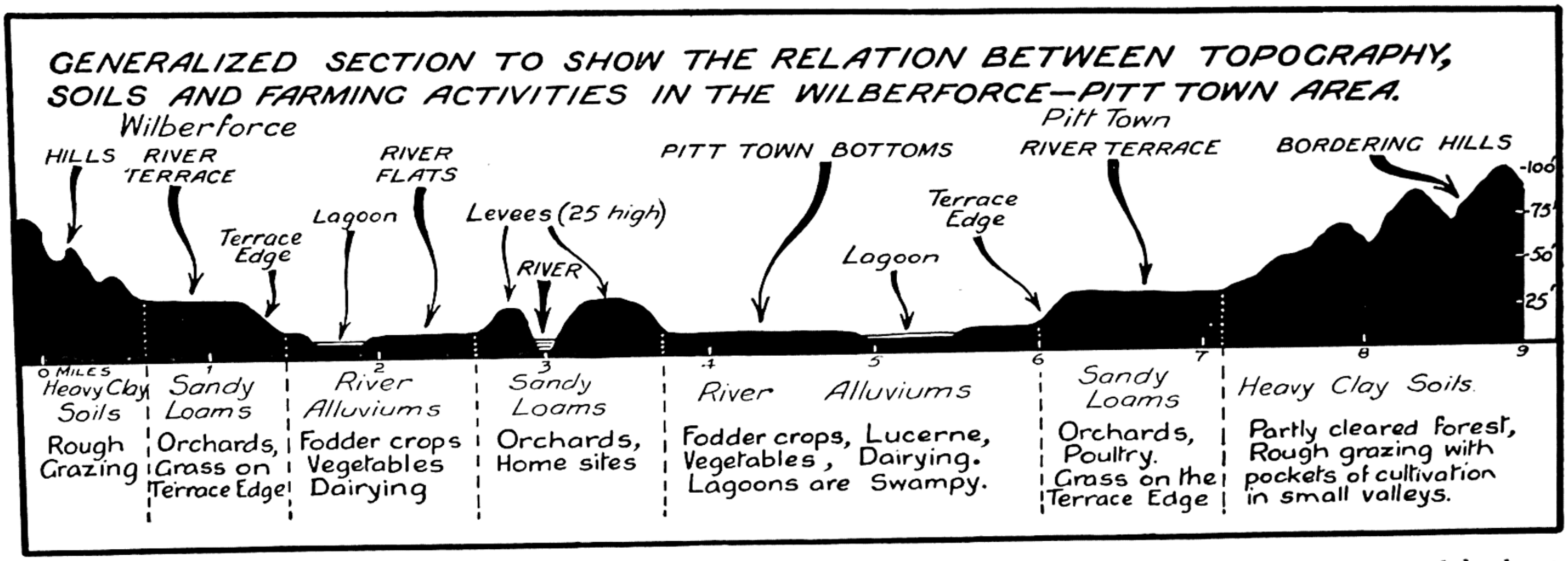

FIG. 130. Generalized cross-section of the Pitt Town-Wilberforce area to show the relation of landforms, soil types and land use.

3. On the higher ground of the terraces and slopes the sandy loam soils favour citrus orcharding, poultry runs and small dairies carrying only 20 to 25 cows.

4. The hilly lands ranging from 50 to 100 feet and lying south and east of the small settlement of Pitt Town carry heavy clay soils. Here the eucalypt woodlands are generally uncleared on the higher parts, but the lower areas are used for grazing. In the more favoured pockets of valley soils fodder crops and vegetables are grown.

5. Together with this variety of small farming are four significant geographical features:

(*a*) The two small townships of Wilberforce and Pitt Town occupy higher ground and serve as local centres for essential services. They have a close relationship with the larger market town of Windsor.

(*b*) The transport pattern of roads across the flats and skirting the terrace serves mainly for the disposition and marketing of the district farm products of fruit, vegetables, milk and eggs in the city of Sydney and its satellite sale centres like Richmond and Parramatta.

(*c*) Holdings are small in size, since those of intensive cultivation have a close dependence upon the

Victorian vegetable growing (Figure 131). Vegetable-growing in Victoria is almost wholly concerned with potatoes and what are classified as other varieties. Onions and peas are important in the State's agricultural activities and as food supplies for urban localities and interstate markets. Worthwhile contrasts may be made with the location and acreage of fruit-growing (Figure 127) in which irrigation is much more significant.

1. There is an obvious concentration in the southern counties about and comparatively near to Melbourne. Here a combination of favourable factors—topography, climate and soils—is closely linked with daily and seasonal supply to the metropolitan market. This shows the existence of a somewhat different set of circumstances from those in the immediate hinterland of Sydney, which is not so naturally well endowed for intensive vegetable-growing.

2. In the Murray system there is a relatively small acreage. Of the irrigation areas themselves, the Goulburn Valley about Shepparton appears to be the most productive.

3. There is a predominance of potato-growing

throughout most of the State. Some counties are devoted exclusively to that cultivation.

Attention is drawn to certain characteristics of the different vegetable industries mapped here.

1. **Potatoes.** Victoria is the chief potato-growing State of the Commonwealth and has a considerable interstate trade. Although the average yields per acre are low, the crop appears on better class land favoured with moderate temperatures and a good average rainfall (30-50 inches annually) fairly well spread throughout the year. The chief districts are Gippsland, the south-west and the central highlands. Note especially the acreage about Ballarat.

2. **Onions.** These grow mostly in the western districts where the rainfall and volcanic ash soils are eminently suitable. Victoria is the only State that produces onions in quantity and the industry is on the increase due in part to the development of a good quality vegetable that stores well.

3. **Peas.** These figure in much the same areas as potatoes, with some specialization in the western counties. The Orbost district in the east is interesting, since it also produces first quality French beans as well as peas for the Sydney market via the coast.

4. **Other vegetables.** There is the usual wide variety of these grown on small properties near the city. Larger scale farming often specializes in one money crop.

(*a*) Considerable quantities of tomatoes are grown solely for processing in the Goulburn Valley near Shepparton.

(*b*) Spray irrigation methods are used along the Murray, e.g., near Mildura, to produce late tomatoes, early beans and off-season lettuce.

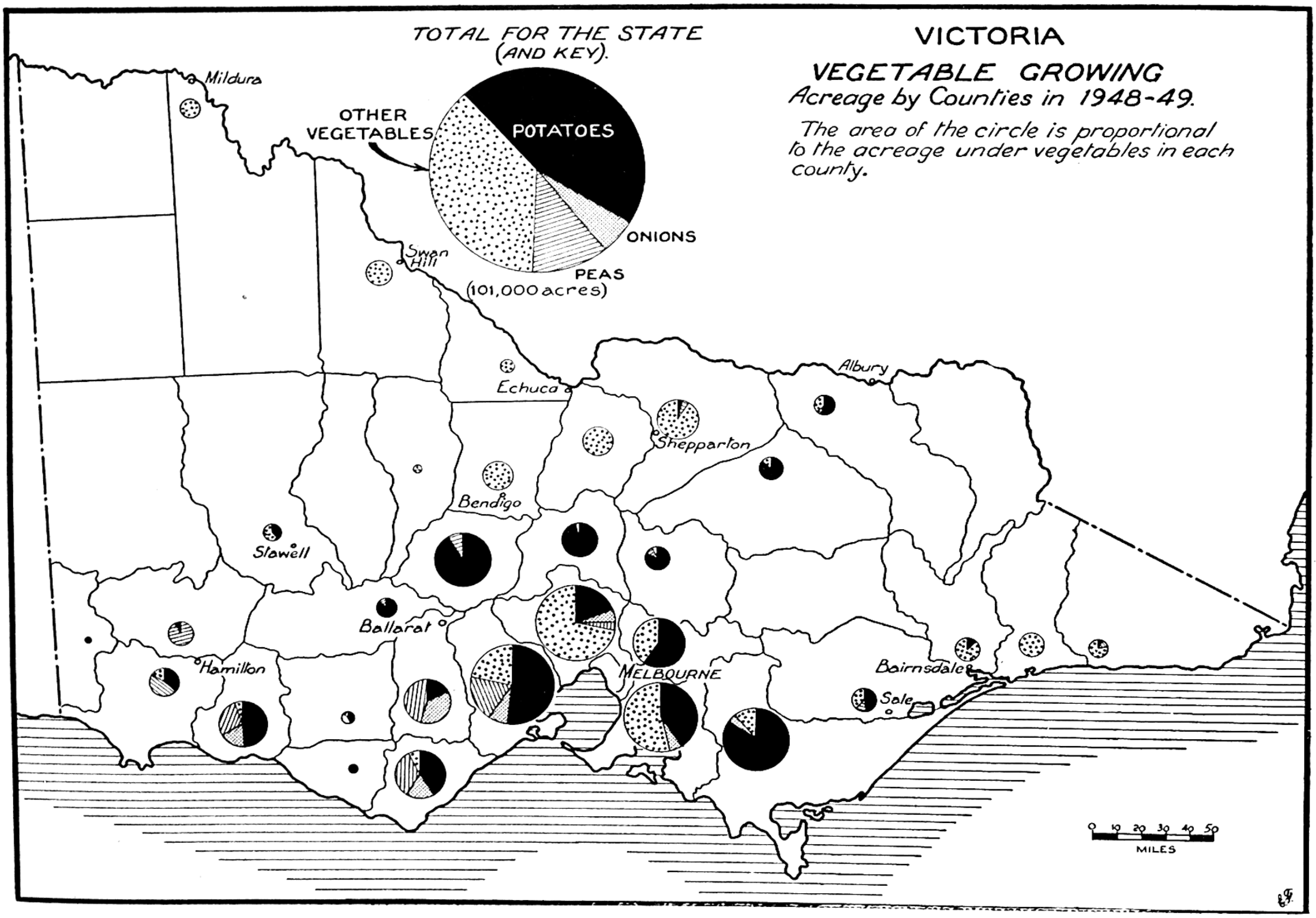

FIG. 131. Vegetable-growing areas in Victoria.

IRRIGATION AND RICE-GROWING IN SOUTH-EAST AUSTRALIA

Australia, with over two-thirds of its area receiving less than 20 inches of rain a year, is the driest of all the continents. In much of the farmland receiving over 20 inches the rainfall is erratic and of marked seasonal occurrence. Such conditions make crop-growing and animal grazing uncertain and somewhat hazardous. Only the artificial supply of water to these areas can add stability to farming, or allow the full and intensive development of those areas possessing suitable soils and topography. Irrigation is not only of importance in expanding and stabilizing present forms of farm production, but certain industries which can flourish only in a hot climate are entirely dependent on it. Thus, in Australia, the production of dried and canned fruits and the growing of rice are made possible by present irrigation schemes.

Examination of the annual and seasonal rainfall maps together with the river drainage map of Australia will show that only in the east and south-east are there areas of highland with sufficient annual rainfall to create permanent streams to flow inland towards the arid interior. It was natural, therefore, that the initial irrigation development should occur in the basins of the Murray River and its tributaries.

Figure 132 broadly summarizes the main landform and climatic factors of the southern half of the Murray-Darling basin. A study of it will show both (*a*) the need for irrigation and water conservation over much of this area and (*b*) the presence of many factors favourable to its development. Six principal factors are associated with the development of irrigation in this area.

1. Water supply. A permanent water supply must be available from reliable and sufficient precipitation on the catchment area. It must be capable of being used at the seasons when needed, especially since stream flow may vary considerably with fluctuations in rainfall. In the area on Figure 132 the Murray, Murrumbidgee, Goulburn and other Victorian tributaries have their catchment areas in an area of adequate rainfall and regular winter snowfall on the highlands

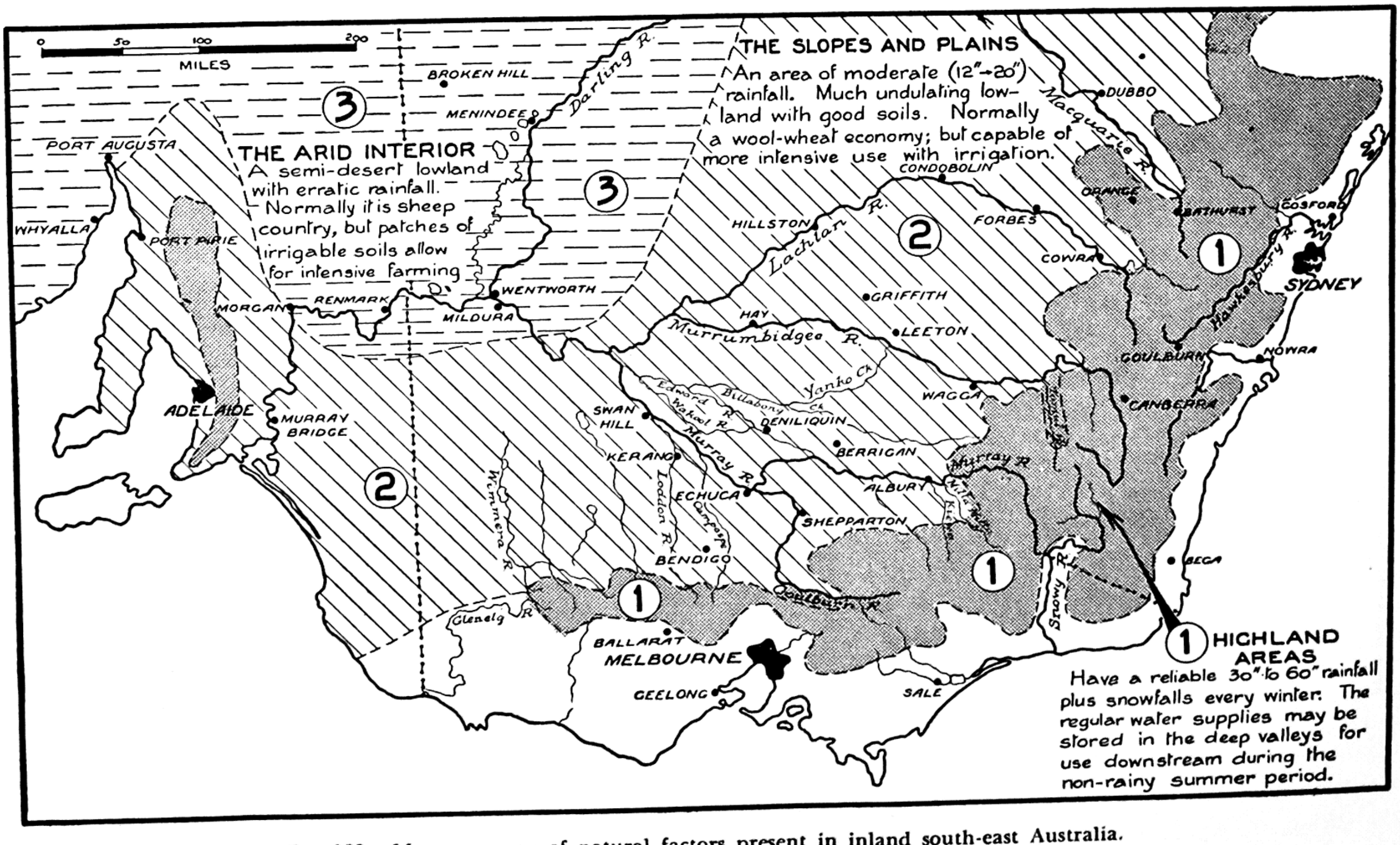

FIG. 132. Map summary of natural factors present in inland south-east Australia.

of south-east Australia. Because of this the water supply is guaranteed and, above all, is fairly reliable. The supply to the Lachlan is more uncertain.

2. Water storage. Dam storage of the run-off is necessary both to regulate the flow and to store water which can be used in periods of low rainfall and small stream volume. The upper courses of all the streams draining from the highlands have sites suitable for the building of dams and the holding of water.

3. Land. Under this heading are treated those features of topography, soils and drainage which are significant in irrigation. The landforms generally must allow for the proper flow and satisfactory spread of water when and where desired. In all the irrigation schemes so far constructed the flow from the dam is by gravitation down the bed of the stream. At suitable points on the lower valley, where the surrounding country is sufficiently flat to permit the spread of water, the land is irrigated either by pumping the water on to the land as at Mildura, Renmark or Curlwaa-Coomealla or by diverting the water from the main stream into canals by means of diversion weirs.

4. Soil. Soil types vary widely throughout the various irrigated lands and each presents special problems in water supply and drainage. The addition of water causes alteration in the structure of the soil. Where an impervious layer is within a few feet of the surface a new water table is quickly developed with disastrous results to deep-rooted plants. Much country irrigated in the United States is underlain by extensive sand deposits which cannot be waterlogged by ordinary irrigation methods as the soil provides its own drainage. Similar country occurs in the Yanco area of the Murrumbidgee Irrigation Area and it was virtually foolproof as regards irrigation management until the heavy flooding for rice-growing in that area filled up the sand beds and created grave waterlogging problems both on the ricefields and on adjoining orchard country. Rice-growing is now prohibited on such areas. In general, water transference over and through soils depends on the manner in which the surface and subsoil clays and sands are arranged, and careful study of this feature by widespread soil surveys is necessary to prevent water damage through the application of too much water.

Within the farm the length of run of irrigation water is directly related to the soil type and the land slope. Thus on sandy soils a long run results in the top end of each channel being hopelessly overwatered before the bottom end has received enough to water the plants there. On clay, especially where the slope is marked, long runs are necessary to prevent the water from accumulating at the distant end before the nearest part has been well watered.

Except on the type of land underlain by sand beds, drainage of some kind is necessary to remove excess water and prevent the raising of the water table level. Most Victorian irrigation schemes have tile drainage, but little or no provision for surface drainage. The Murrumbidgee Irrigation Area has a complete system of surface drainage but is only now beginning to plan seriously for tile drainage. The water from the surface drainage channels is often used on outlying areas for stock supplies and further limited irrigation of fodder crops, as with the Wah Wah district.

5. Climate. Climatic influences are significant in an area given over to irrigation, since they determine to a high degree the type of agriculture which can be developed satisfactorily. Within the area shown on Figure 132 the rainfall varies from eight inches in the arid interior to 30 inches along the inner foothills of the highlands. It occurs mainly in the cooler autumn and winter months while the summers are very hot with droughts a possibility from time to time. These conditions make irrigation a necessity over the summer period and it is in such lands as these with a moderate, but seasonal, rainfall that irrigation succeeds best.

6. Markets and transport. Markets for the disposal of products coming from irrigated lands are obviously necessary if schemes are to be economically sound. Even so, satisfactory transport must be available to place the produce where it may be sold. As will be seen in the remarks on Figure 133, the products from the irrigated areas in this region are both used locally and forwarded to the cities. Here they are either consumed by the urban populations or exported overseas.

Marketing of the produce from the horticultural areas has raised many problems in packing, quality, publicity and prices. These have been solved and to-day expansion of the areas depends mainly on the amount of water available rather than on the acreage of irrigable land or the doubt of obtaining a market for the article produced.

Present-day development. Figure 133 shows the areas at present irrigated, together with the broad types of irrigation used throughout this region. The following features should be noted:

(*a*) Shaded areas on the map show that considerable development of irrigation of one form or another has taken place since the Chaffey Brothers opened their first scheme at Mildura in 1884.

(*b*) Water stored in the large dams on the headwaters of the various streams is now applied to three broad types of land-use.

(*i*) Horticultural irrigation, which consists of intensive farming of small areas to produce fruit, vegetables, and grapes.

(*ii*) Mixed farming, extensive irrigation, whereby the water is used to stabilize existing farming industries and to allow for the introduction of new forms of animal products. In this case the

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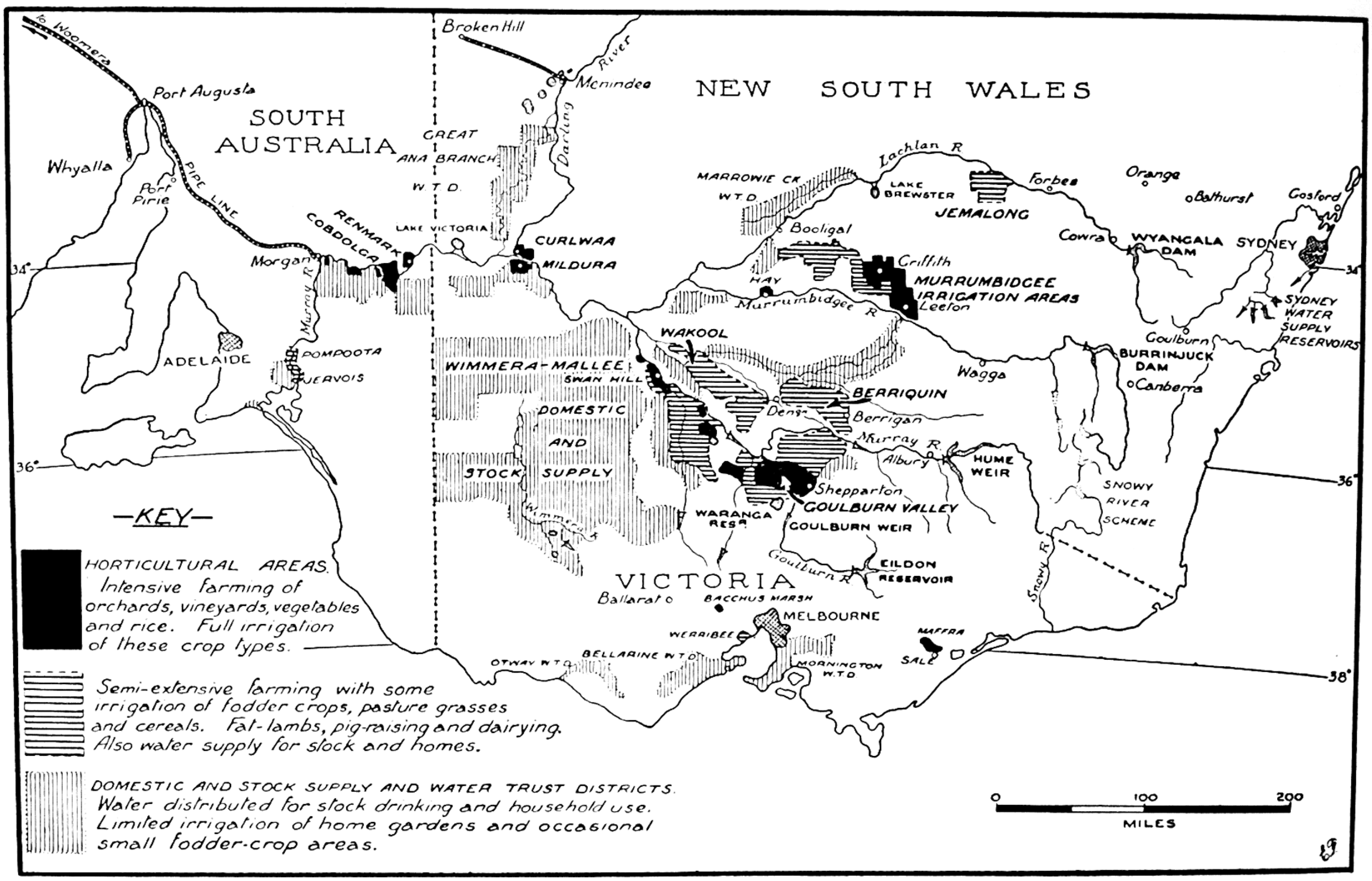

FIG. 133. The development of irrigation in south-east Australia.

water is used in the first place to supply stock drinking water and domestic water for the homes.

Secondly, some of it is applied to the irrigation of newly planted wheat crops within areas where irrigation water is available. This is rather limited because of the economic costs of such procedure.

Thirdly, farmers are allowed to irrigate planted fodder crops and pastoral grasses such as lucerne, subterranean clover, wimmera rye. Usually only about one acre in six or eight on each farm is thus irrigated. The products from these irrigated plots are then fed to fat lambs, dairy cattle or pigs on the farm, or are cut and baled to be sold to adjoining purely pastoral areas.

Fourthly, in the Murrumbidgee Irrigation Area, Tullakool Area and Wakool Irrigation District rice is an important field crop in an intensive mixed farming economy (see page 160).

The general expansion of the third type mentioned above throughout northern Victoria and to a lesser extent in the Wakool, Deniboota and Berriquin districts of New South Wales, has resulted in a change of land use from sheep-grazing for wool with wheat-growing to one wherein these are now largely subordinated to dairying (see Figures 110 and 111), fat lamb production (see Figure 133) and pig-raising (see Figure 101). This has resulted in a much more intensive form of land use, accompanied by a higher population density and a greater money return from the area generally.

(*iii*) Domestic and stock supply and water trust districts. Figure 133 shows that these occupy the greatest area of lands under irrigation. In them the aim is to supply regular water for stock drinking and domestic purposes. This is to give stability to the important wool sheep industry found in these areas. The farmers are also allowed water to irrigate limited orchards and vegetable gardens to supply their own needs in fruit and vegetables.

(*c*) Early development in irrigation was concerned mainly with the horticultural types; but during the past 25 years these have reached market saturation point. Irrigation development now is concerned primarily with the growth of fodder crops and water supply for stock, and future expansion will be mainly along those lines. There is an almost unlimited market for the meat, dairy produce and fodder crops that can be produced by this form of irrigation, whereas the market for fruits (canned, dried or fresh) is limited.

With rice, the problem is one of limited water supplies and sufficient suitable land rather than one of markets.

(*d*) An interesting, and very recent, development of water supply is shown with the pipelines carrying water from: (*i*) Morgan to Whyalla and several places in between, with an extension running to the Woomera Rocket Range; and (*ii*) from Menindee to Broken Hill. In both cases the good supply of water will give stability to important industrial and mining occupations in desert areas.

(*e*) Victoria has developed several irrigation schemes (e.g., Sale, Werribee and Bacchus Marsh) on the coastal side of the highlands. These are concerned mainly with intensive land use for fruits, vegetables, tobacco and fat stock.

(*f*) Most of the large dams have hydro-electric power stations at the base and generate power to feed into the interconnected grid system of south-east Australia. Victoria, in particular, has concentrated on this aspect and on the Kiewa River is now building a special hydro-electric plant which will generate over 350,000 Kilowatts of current.

(*g*) The Snowy River Scheme is shown in outline on the map. It is easily the greatest conservation scheme ever undertaken in Australia and has five main objects:

(*i*) The storing of all surplus waters in the upper Snowy, Eucumbene, Tumut and Murrumbidgee rivers.

(*ii*) The diversion of these waters through tunnels (and power stations in the tunnels) to the Murray and Murrumbidgee rivers. In the case of the Snowy and Eucumbene this will mean the diversion of the waters of a coastal stream to inland rivers.

(*iii*) The supply of large amounts of additional water to the Murrumbidgee and Murray rivers to allow expansion of fodder crop growing and intensive stock farming, throughout the southern Riverina and northern Victoria, together with limited expansion in horticultural irrigation.

(*iv*) The generating of over 2½ million kilowatts of electricity to feed into the interconnected grid system.

(*v*) The possible development of new industrial centres throughout the area relatively close to the upper Murray. This will help in the general decentralization of industry from the large cities, a policy which is part of the planned future development of Australia.

General results of irrigation. The large-scale projects outlined here have been the concern of the State governments and in many ways they have proved difficult to administer. Apart from the initial capital cost of storage, channels and transport, the income from water rates, charges and sales paid by farmers of the area have been barely enough to meet the cost of operation and maintenance. On the other hand the over-all results may be said to have been more than satisfactory. This can be seen in the increase in population, thriving farms, trading and service centres, and the development of rail and road patterns, local and oversea trade. Above all, the successful decentralization of people into rural areas with increasing public amenities is of paramount importance to growth in national progress. It is for this reason that the implementation of the great Snowy River scheme is being watched with keen interest, since the supply of water, power and light from it is bound up with the future of the Riverina in general and the Murrumbidgee and Murray irrigation areas in particular.

Murrumbidgee Irrigation Area. Generalized pattern of land utilization (Figure 134). In examining this map attention should be given first to the general location of the Murrumbidgee Irrigation Area in relation to the Murrumbidgee River itself, from which the necessary water supplies are drawn. The area lies to the north and is served by a main canal and a series of lateral canals. The pattern of these is stressed in the inset sketch. This lay-out should be studied more closely to see how the farmlands are served by irrigation channels and ditches. Some small details are given in the notes relating to farm types (Figures 135 and 136). The pattern of urban settlement is significant. It shows a series of townships—except Narrandera—which came into being mainly as a result of the irrigation scheme. They represent service centres. There are also a variety of activities associated with the processing, transport and marketing of the local grown product, e.g., the Leeton cannery and the Griffith rice mill.

1. The crossed lines indicate the large area farms which are utilized for the growing of rice, pastures and wheat.

2. The dotted areas represent the horticultural farms used as orchards, vineyards and vegetable gardens.

3. The vertical lines mark areas which, while not subject to irrigation themselves, are utilized as part of irrigation farms situated elsewhere. The land is used for wheat-growing and sheep-raising.

4. The diagonal lines show the Red Gum Forest Reserve along the Murrumbidgee.

Relative to the above divisions the following comments are important:

(*a*) The land use pattern of the Murrumbidgee Irrigation Area is really divided into two groups only: (*i*) large area farms; and (*ii*) horticultural farms. Other boundaries are not readily mapped because of the interchange of farm enterprise on the one farm. There

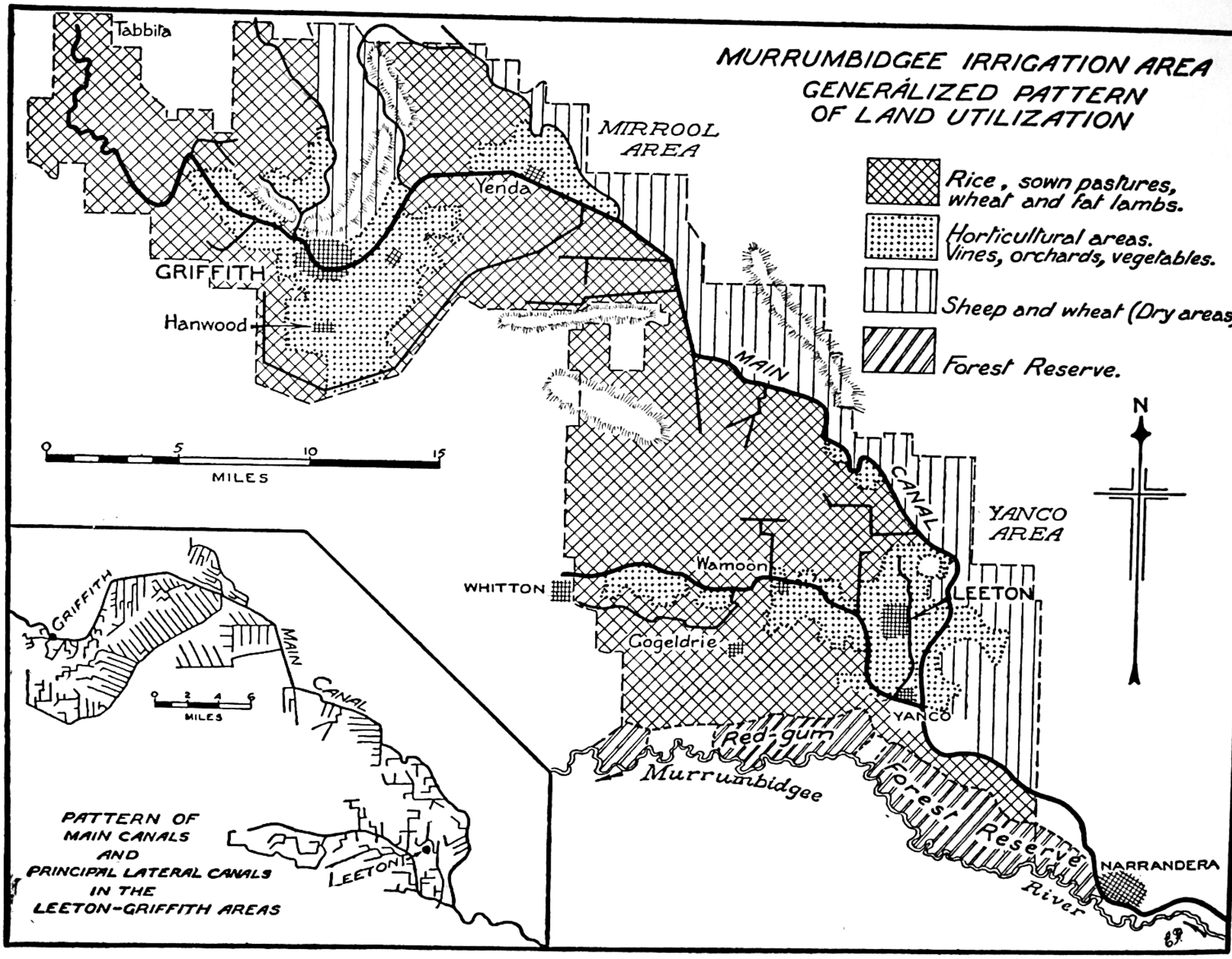

FIG. 134. General pattern of land utilization in the Murrumbidgee Irrigation Area of New South Wales.

is one difference which may be of interest. Very few grapes are grown in the Yanco Irrigation Area and there are no wineries, whereas Mirrool is the principal grape-growing area in New South Wales. This development is associated with the fact that wineries were first erected in the Mirrool Area. The horticultural soils of the two districts are much the same.

(*b*) It is not usual to find a farm given over to one horticultural crop. The actual crops grown will depend upon farmer preference and the soil types present (Figure 135). The lightest, most readily draining soils are used for citrus-growing, but they are also suitable for all other fruit trees and vines. Somewhat less readily drained soils are considered as second grade for citrus but quite satisfactory for stone fruit, pome fruit and vineyards. Somewhat heavier soils again are not considered suitable for citrus but are satisfactory for stone fruit, pome fruit and vineyards. Finally, the heaviest horticultural soils are only suitable for pome fruits and grape vines, while some land is considered unsuitable for any type of horticulture.

(*c*) The large area farming pattern is dominated by rice-growing, which is the central enterprise of their land use pattern. It is only during the last five or six years that sown pastures have been important at all. There has been a very rapid expansion in the area sown to pasture and a consequent increase in the fat lamb production. Associated with this there has been a marked, but as yet still small, development in the fattening of cattle. Wheat has been an important subsidiary but is declining in significance.

(*d*) Dairy farming does not find a place in the Murrumbidgee Irrigation Area land use pattern.

(*e*) The vegetable industry is also of some importance in the Murrumbidgee Irrigation Area utilization, but it does not take on any particular pattern and is mixed up with horticulture and large area farms. In the former case it is often associated with run-down

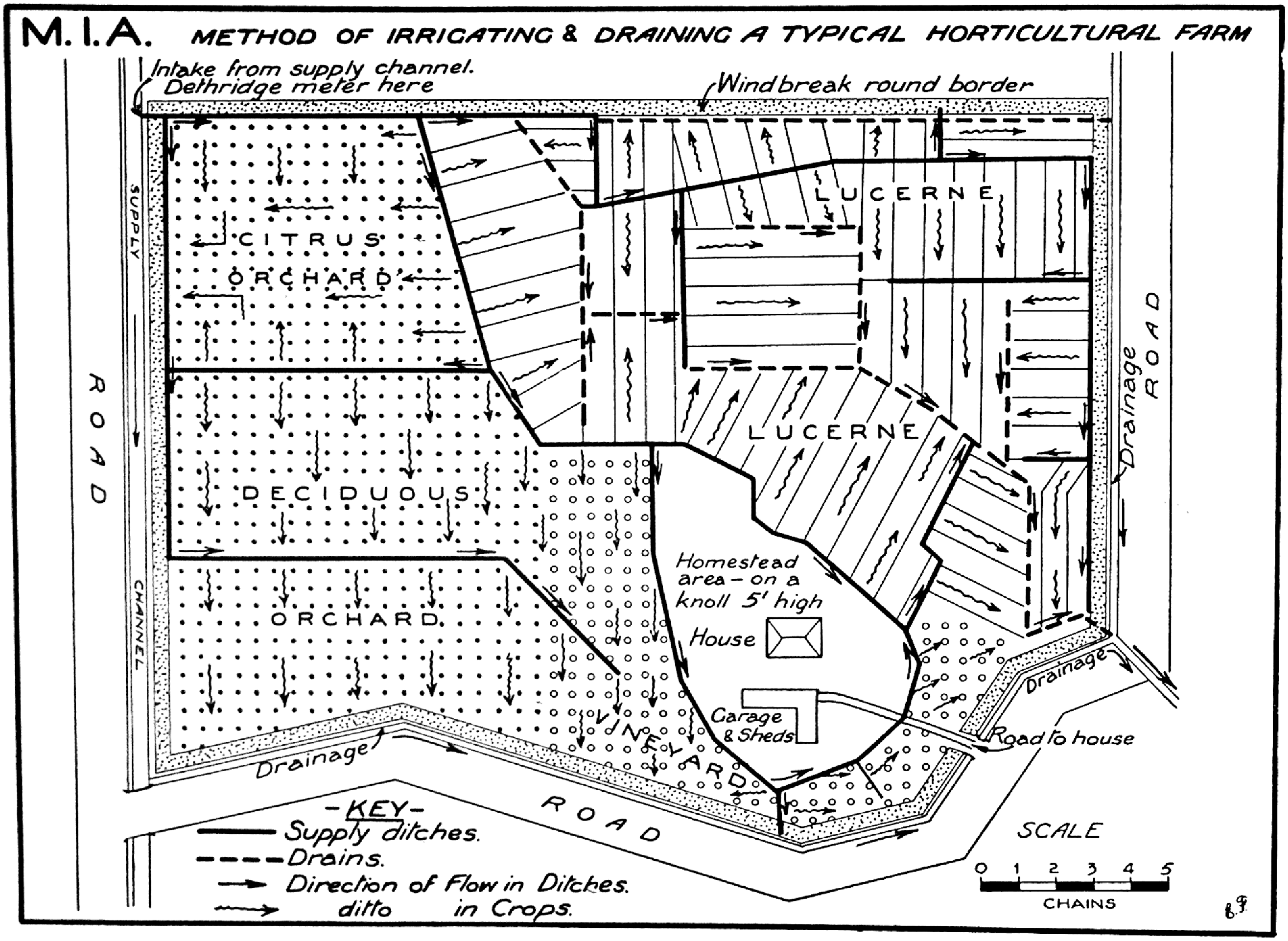

Fig. 135. Sketch-map to show the lay-out and method of irrigating and draining a typical horticultural farm in the Murrumbidgee Irrigation Area (*By courtesy Irrigation Commission, N.S.W.*).

horticultural farms, in the latter with short term leases of a small section of the farm.

Plan of horticultural farm (Figure 135). 1. General. In this sketch of a typical farm devoted to fruit-growing in the Murrumbidgee Irrigation Area certain general features of the lay-out are worthy of notice, since they are the outcome of the use of irrigation measures for horticulture.

1. The croplands are arranged so that whilst a supply channel takes water to them, there is ample provision for draining off the surplus. Both are related to the slope of the land. In this way the actual irrigation can be controlled.

2. The amount of water used by the farmer is measured at the entrance to the property from the main supply channel by what is known as a Dethridge Wheel.

3. The homestead and farm buildings are located on a slightly higher area. Sheds protect machinery and are needed in the packing and storage of fruit.

4. The growth of a windbreak about the whole property is to prevent damage to trees, especially when in fruit.

5. Easy access to a main road is important because it is convenient for the moving out of crops to canneries, wineries and railheads, as well as for the moving in of farm and domestic supplies.

2. Detail. The type and location of the crops shown may be determined by certain factors which are recognized by research workers in irrigation to be significant.

(*a*) The four main classes of orchard crops usually found in the Murrumbidgee Irrigation Area are citrus, stone and pome fruits (deciduous) and vines.

(*b*) Particular crops require a particular combination of soil and slope as affecting both growth and drainage.

(*c*) Other natural factors of the environment include the incidence of frost and heavy rainfall.

(*d*) Economic considerations are also to be taken into account. The farmer's selection must aim at the proper handling of those exacting crops which in the long run are the most profitable. He may also need to run to pasture for special reasons, e.g., the lucerne on this farm.

The above details apply in the main to new lands and do not take into account older properties where problems of waterlogging and salting may have arisen already. Detailed mapping of the horticultural areas has been carried out and the results of research by the C.S.I.R.O. and the New South Wales Department of Agriculture are being made available to farmers through a special regional agricultural service called the Murrumbidgee Irrigation Area Agricultural Extension Service.

Rice-growing in Australia. 1. General. The growth of rice in Australia represents a special development in the Murrumbidgee and Tallakool areas and the Wakool Irrigation District of New South Wales. It shows the adoption of modern machine farming methods for the cultivation of a major "hand-cultivated" crop of Asia. Similar methods are used in the United States, e.g., California and Louisiana, where the total output of rice is approximately a million tons a year and where the crop has been grown since 1912. Of interest also is the fact that in several parts of Indo-China and Thailand, machine farming has been introduced for rice growing on newly opened lands.

2. Development. (*a*) Rice-growing was started in 1924 when 153 acres were sown on the Murrumbidgee Irrigation Area after experiments had shown that seed from California was suitable to the conditions prevailing in New South Wales. With the return of over 100 bushels to the acre it was felt that land which was proving unsuitable for the normal crop of fruit could be turned to good use if plenty of cheap water, suitable grain types and mechanized harvesting could be obtained.

(*b*) All these requirements were met. The industry developed rapidly and by 1929 was producing all Australia's requirements. It was definitely a cash crop and its development was aided by a protective tariff of a penny a pound on imported rice.

(*c*) In 1928 the Rice Marketing Board was established to control the area planted each year and the disposal of the crop. This step was necessary as the sale of export rice was not easy in the face of competition from the East Indies, and the control of production was required to maintain a reasonable price for the grower. Also, the amount of water available for rice cultivation was limited. All rice now passes through the Board, which disposes of it to the best advantage.

3. Location. Up to 1943 all rice was grown in the Leeton-Murrami-Yenda areas of the Murrumbidgee Irrigation Area, but in that year the Water Conservation and Irrigation Commission planted 4,000 acres at Tullakool in the Wakool Irrigation District as a war measure to meet loss of supplies from the East. It was successful but continued in production for three years only. In 1948 the area was re-opened as a soldiers' settlement and twenty-four farmers are now living there. The total area under rice cultivation in New South Wales varies between 30,000 and 45,000 acres a year according to the water supplies allotted by the Irrigation Commission. As it takes 4,000 tons of water to grow one ton of rice the Commission has to guard against excessive amounts being used for this crop. About 80 acres are planted with rice on each farm, though several special farms have greater areas. The average yield has been between 1·5 and 2·2 tons per acre during the past ten years. This is much higher than the average for Asian countries.

4. Requirements for growth. Successful rice cultivation in Australia depends on five factors.

(*a*) Level land with an impervious subsoil to allow for impounding water whilst the plants are growing.

(*b*) Satisfactory surface drainage and freedom from weeds.

(*c*) A dependable water supply during the growing period so as to maintain a depth of six inches over a large area of country despite losses by seepage, evaporation and transpiration.

(*d*) Temperatures of at least 68°F. during the growing period. (It is a summer crop in the Murrumbidgee Irrigation Area.)

(*e*) An absence of sudden changes of temperature.

5. Farming practice. Rice is grown in the Murrumbidgee Irrigation and Tullakool areas in "bays" of from four to six acres in area. These are specially prepared fields enclosed by an earthen embankment. The general farming procedure is as follows:

(*a*) The ground is worked over thoroughly during the winter and spring and the seeds are sown in September and October by using a wheat drill. About 130 lb. of seed per acre are used, sometimes with chemical fertilizer. The ground is flooded after sowing and the water is allowed to soak in. Once the plants have germinated and are about two inches high the water is run on to the bays and its depth gradually increased with the increasing height of the growing plant until the water is about six inches deep. It is kept at this depth (or even a greater depth) until the rice is ready to harvest. When the plants lose their greenish tinge and are ripening, the water is cut off and the field allowed to dry ready for harvesting. This is done during April and May by using special machines which cut, thresh, winnow and clean the

grain after the style of an ordinary wheat harvester, but adapted to handle the much heavier yield of rice, i.e., over 90 bushels per acre as against 15 to 25.

(*b*) Rotational cropping is practised to maintain soil fertility and to replenish the nitrogen removed by the gross-feeding rice. The common rotation is rice followed by a three-year to five-year pasture rotation. Wimmera rye and subterranean clover are the crops grown during this period and they are used as stock fodder. This is followed by a crop of grazing oats (i.e., a type of oats which can be grazed off by stock and then allowed to grow to yield a grain crop) and then by another rice crop. The subterranean clover restores the lost nitrogen and the grazing oats remove excess of this chemical and thereby prevent excessive leaf growth in the following rice crop.

(*c*) The raising of sheep, principally crossbreds for fat lambs, is usual on the rice farms. Sheep help to keep the weeds under control, especially on the embankments between the bays; they graze on the bays after the crop is harvested; they feed on the rotational pastures; and they provide an important supplementary source of income for the farmers.

(*d*) After being harvested, the rice is sent immediately to the polishing mills, since the high oil content in the hulls causes deterioration. Milling operations are carried out in Griffith, Leeton, Yenda, Cootamundra and Echuca.

(*e*) By-products from the milling are bran and pollards, which are used for stock fodder. Often the oil is extracted before selling for this purpose. Hulls are used for packing, polishing material, cellulose and for soil enrichment in the orchards. As well as being used in the form of grain, rice is made into breakfast foods, starch and rice meal, while the flour is used as a base for face powder. Unhusked rice is also a valuable sheep food and prior to World War II was used during droughts.

6. Future prospects. There has been some waterlogging and formation of salt spots in places as the result of the intensive flooding in rice fields raising the water-table in adjoining areas. This caused damage to adjacent orchards, especially where there was a deep, sandy subsoil and the Commission is gradually removing rice cultivation from such areas.

On the other hand, the rice has benefited areas of poor soil, since it leaves heavy clays more friable and the extensive root system of the plant adds humus to the soils. Most farmers possess enough land to practise a four-year or five-year rotation.

In comparison with older rice-growing countries, the Australian rice land has grown very few crops, but careful farm management has resulted in continuous high yields and there seems no reason to fear any falling-off if these methods are maintained, or even improved on. Extensive research is being carried out on such stations as the Yanco Experimental Farm and from this it is hoped to learn more of the behaviour of

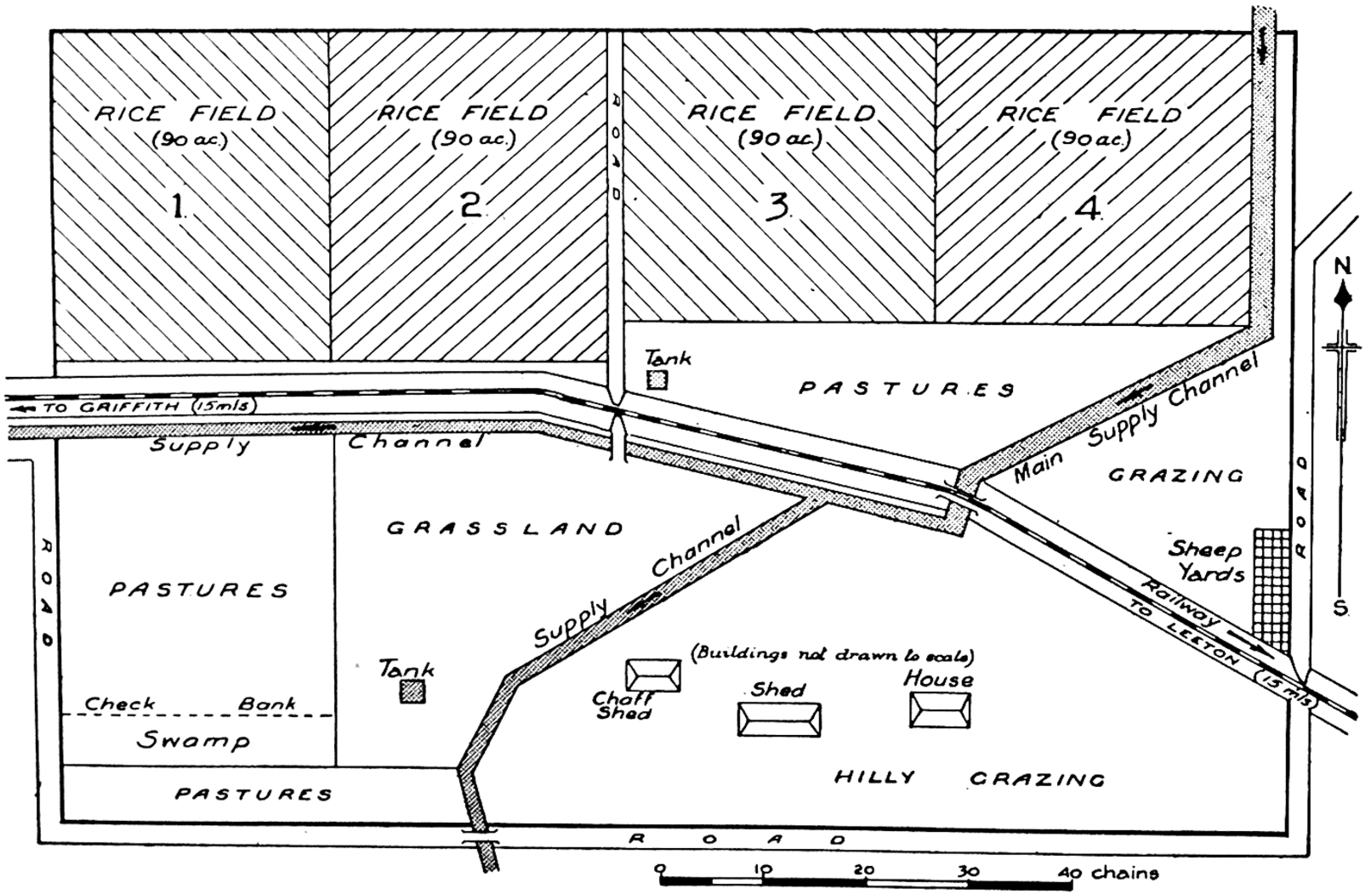

FIG. 136. A sketch-map of a rice farm in the Murrumbidgee Irrigation Area.

soils and crops under irrigation conditions, as well as the control of pests and diseases. Farmer education is the responsibility of the Murrumbidgee Irrigation Area Agricultural Service—an experiment in decentralized administration being conducted by the New South Wales Department of Agriculture.

With the present controlled prices and assured oversea markets, rice is a very profitable crop for the 500 growers, but in many ways it is a bad crop for Australia. The enormous amount of water used for its growth could be put to better uses in a "dry" continent, where the inhabitants merely use rice as an accessory food, and where a protected price is necessary to enable the farmers to produce the crop profitably.

A rice farm in the Murrumbidgee Irrigation Area. Figure 136 is a simplified plan of a typical rice farm situated 15 miles east of Griffith. The following facts should be noted:

(*a*) It has a total area of 960 acres, of which 360 acres are devoted to rice-growing. This is classified as an "extensive" type of farm.

(*b*) The rice is grown in each of the 90-acre fields in succession, so that there is a four-year rotation. The fields are enclosed with earth embankments and are subdivided into some 20 bays by other embankments. This facilitates flooding when the crop is growing and prevents winds from banking the water on one side of the field.

(*c*) Oats, wheat and fodder crops are sown on the rice fields when they are not under rice. Oats and wheat crops are harvested and the grain sold as a supplementary source of income.

(*d*) The balance of the farm is divided into paddocks which are partly under natural grasses and partly sown with pasture grasses. Sheep are grazed on these paddocks, as well as on rice fields when they are lying fallow. Wool and fat lambs are sold.

(*e*) The paddock tanks are necessary, as the stock are not allowed to drink in the canals, which are fenced off. The tanks are filled from the canals by means of drains.

(*f*) As with the farm in Figure 135, the house is situated on hilly ground.

SOIL EROSION AND SOIL CONSERVATION IN AUSTRALIA

(See also "Conservation of Natural Resources", *Regions and Men*)

Normal soil erosion (or geological erosion) is the removal of the surface covering of the earth by the action of wind and running water. It is a natural process and does not affect plant and animal life, mainly because new soil replaces that removed. There is a balance among plants, climatic conditions, soil erosion and soil formation.

Soil erosion as referred to in modern geography means the accelerated removal of the surface soil brought about by man's interference with the balance of nature. Such erosion is caused by running water in wet regions and by both wind and water in drier areas. It takes place only after the natural vegetation cover has been wholly or partially removed to make way for various farming activities. Clearing of vegetation is necessary to provide farming land to supply food and raw materials for mankind. Erosion in these lands results either from neglect to maintain the minimum vegetation cover to protect the land, or from unwise methods of land use. Where this has occurred, not only the fertile topsoil with all its valuable plant foods is swept away, but the waste material may smother other areas of fertile land. During this process of accelerated erosion streams carve deep gullies through ploughed fields or down unprotected slopes, and waste material blocks the channels of rivers to cause sudden floods, silt up dams, fill river waterholes, silt up harbours and kill the fish in the streams.

Such devastating erosion resulting from widespread clearing of forested lands followed by unwise farming practices, has played an important part in history. It has been responsible, in large measure, for the disappearance of centres of civilization in Persia, Mesopotamia, Central Asia, Syria and Tripoli. Wholesale tribal migrations of early history can be related to soil erosion's ruining pastures over wide areas to create "dust-bowl" conditions on well-grassed plains.

Soil erosion and conservation in Australia. The chief regions of soil erosion in Australia may be divided into two broad groups: (*i*) those caused by wind erosion; and (*ii*) those resulting from water erosion.

1. Wind erosion occurs in the drier pastoral areas of inland New South Wales, Victoria, southern Queensland and northern South Australia. These areas were originally covered with woodland, grassland and shrub-steppe vegetation which afforded sufficient protection to the soil in them. Six principal agents have been responsible for the destruction of the vegetation in these areas:

(*a*) Ringbarking of woodlands to create pasture grazing lands. In this process it was quite common to remove all the timber in order to get the maximum amount of grassed paddocks.

(*b*) Overstocking, which means that in the original opening up of the regions for grazing and in subsequent good seasons, too many cattle and sheep were placed in the paddocks. The fodder there was not sufficient to carry them over long periods, especially when dry spells occurred. The result was that not only was plant life eaten down, but regeneration was prevented. The plants died out and the unprotected surface soil was blown away in hot, windy weather. And it is very important to remember that dry years in the inland are always characterized by such weather. The appalling dust storms over south-east Australia during the summer of 1944-45 were evidence of the removal of inland surface soils by wind.

(*c*) Rabbits assist in plant removal by eating the grass and shrubs in competition with the stock, thus ringbarking shrubs and small trees, and by eating the scanty grass growth of dry years, forcing the sheep and cattle to overgraze the shrub country when the grass has been eaten out.

(*d*) Droughts kill weaker vegetation, but as they are a natural climatic feature of inland regions would not seriously harm the native vegetation in areas unaffected by heavy stock grazing.

(*e*) Arable farming on marginal lands. In such areas as the Victorian mallee and the lower Lachlan Valley in New South Wales, the processes of wind erosion have been greatly accelerated by attempts to grow wheat crops. Here the rainfall is low and the soils light and sandy. Removal of the vegetation, coupled with ploughing for crops, has converted many square miles of this woodland country into a desert within a decade.

(*f*) Water erosion is not normally a serious factor in semi-arid lands. Nevertheless, the sudden heavy summer storms of these areas can do great damage on land where the topsoil has been exposed by overgrazing or marginal crop farming.

2. Water erosion occurs in wetter regions such as the wheat lands proper, the highland regions and the coastal valley slopes throughout south-eastern Australia. Here the major factor is water running down sloping land after the natural vegetative cover has been wholly or partly removed to make way for

farming. The two principal forms are (*a*) sheet erosion; (*b*) gully erosion.

(*a*) Sheet erosion is the widespread removal of surface soil more or less in a uniform layer. It is often not noticed until all the topsoil has been removed and the land shows large areas of bare ground.

(*b*) Gully erosion means the formation by running water of channels or gullies in paddocks. It is usually found on steeper slopes, or where road drainage has been channelled into a paddock, and is the result of the run-off water being concentrated in well-defined courses. It is readily seen and its result, if unchecked, is to cut the paddock into many irregular patches with gullies up to 20 feet deep separating them. The waste material from these gullies quickly fills paddock tanks and chokes streams draining the area. Floods are then more frequent and more disastrous because the now shallow valleys cannot carry away the same volume of water as before and it spreads over the surrounding countryside. The disastrous floods which to-day affect all the rivers of south-east Australia are in part related to the widespread destruction of timber resulting in water erosion on the watersheds and slopes of the valleys of those rivers.

3. **Soil conservation.** The purpose of all soil conservation programmes is fourfold: (*a*) to halt the soil erosion now occurring; (*b*) to protect all land from further erosion; (*c*) to reclaim all eroded areas; (*d*) to improve the soil so as to restore and increase its fertility.

The primary cause of soil erosion is the deterioration or destruction of the protective vegetation. The first step in conservation is the rehabilitation of the vegetative cover. In this manner all soil conservation schemes are closely linked with timber conservation and the two government departments of soil conservation and forestry work closely together.

In grazing lands, conservation aims at building up the density of pasture cover by so stocking the land that a balance of vegetation is always present to protect the soil. This may be achieved by keeping the animal population within the pre-determined safe limits and by subdividing properties to allow for rotational grazing with resting periods in each paddock to allow natural regeneration of pastures. In addition, improved pasture grasses and top-dressing of pasture lands with fertilizers is practised where possible. It is also necessary to eradicate the rabbit pest, though this may be difficult and costly on the large properties in the drier lands of the interior.

On agricultural farming lands and grazing lands on the wetter slopes and tablelands the methods are different. Here the first step is the preservation of all existing timber on watersheds and along the valleys of streams. It is now illegal in New South Wales to cut or kill any trees within 66 feet of any watercourse or stream without permission from the Forestry Officer. Many such areas have, in the past, been almost denuded of trees, so that widespread re-afforestation schemes need to be carried out. This is being done on the catchment areas of all streams on which storage dams are being built.

In areas where erosion, or the danger of erosion, is severe, it is necessary to supplement the vegetative measure by mechanical aids. Then the aim of the conservationist is to check the flow of water down sloping land in addition to repairing the damage that has already occurred. Aids to conservation here include the construction of pasture furrows or contour banks to check the flow of water and increase its absorption into the soil. Any water not absorbed runs slowly off along the contour into specially constructed and heavily grassed waterways which conduct it harmlessly down the slope to a dam or into the natural drainage streams of the area. The farmer also adopts practices which ensure that the soil left bare is reduced to a minimum and that all stubble is ploughed into the soil to increase its humus content (and hence its absorption properties).

Contour ploughing and planting, especially with "open" crops like corn or fruit trees, is adopted. Each furrow now acts as a small contour bank and thus increases the absorption of water to a maximum. Strip cropping, which means the growing of pastures and crops in alternate strips along the contours, is also advised. It is not as yet widely adopted in Australia though it is becoming very common in the corn belt of the United States.

All geography students should be fully aware of the problems of soil erosion and soil conservation. They should follow up this brief outline by obtaining and studying the brochures and pamphlets issued by the soil conservation (and other conservation) departments of the various State governments.

INDEX

Note: Italicized numbers (for example, *108*) refer to pages on which maps occur.